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The Journal of the *International College of Surgeons*

Special Issue Honoring

PROFESSOR DR. ARNOLD JIRASEK
First President of the International College of Surgeons

On His Sixtieth Birthday

Guest Editor: **Dr. Louis F. Plzak**

Vol. X ***September-October, 1947*** **No. 5**

OFFICIAL TRAVEL REPRESENTATIVE

FOR THE

SIXTH INTERNATIONAL ASSEMBLY

OF THE

INTERNATIONAL COLLEGE OF SURGEONS

ROME, ITALY, MAY, 1948

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International College of Surgeons

In Honor of

Professor Arnold Jirasek

This volume is dedicated to the first President of the International College of Surgeons, Professor Arnold Jirasek, who, having reached his sixtieth birthday, has completed 20 years of service as chief of the first Czech surgical clinic of Charles University, Prague.

Today he enjoys the distinction of being the foremost surgeon of Czechoslovakia, that small democracy of Europe conceived by Masaryk, which still remains the last outpost of democratic thought in Europe. As a surgeon, his ability and contributions to surgical literature are known not only in his own country but far abroad, and they have had a profound impact on surgical thought. As a teacher of medical students and young surgeons he has gained the respect and admiration of all who know him. As a leader in his profession, his vast knowledge of the basic sciences of anatomy, physiology and pathology has done much to coordinate these into Czech surgery, and thus elevate it to modern standards.

In appreciation of this leadership and as an expression of friendship, the following are listed as his former students, fellow workers and American colleagues who have contributed to this special number:

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PROFESSOR ARNOLD JIRASEK

Arnold Jirasek

CZECH SURGEON AND NEUROSURGEON

Professor Dr. Arnold Jirasek was born in Prague on July 3, 1887. After attending the academic Gymnasium school, he entered upon the study of medicine at Charles University and received his doctorate December 13, 1910. He began his clinical studies as an externe in internal medicine for a period of one year under the leading Czech internist, Professor Thomayer. The following year he served as army doctor, and in 1912 he returned to Prague to begin his surgical career as an interne at the first Czech surgical clinic of Professor Kukula. This internship however, was interrupted, for the Balkan war was in progress and Jirasek volunteered with a group of Czech surgeons to serve on the Balkan front. He returned in 1913 only to have his training again interrupted by the start of hostilities of World War I; in 1914, he left with the first Czech surgical team as army surgeon for the Russian front, where he served until July, 1917. He was then placed in command of the third Czech surgical team and was transferred to the Italian front, where he remained until cessation of hostilities in November, 1918. On his return to Prague, Jirasek was named full assistant at the Kukula surgical clinic. His industry, scientific demeanor and numerous contributions to surgical progress, as well as his great ability as a teacher, earned for him, in December, 1923, the rank of professor in general and special pathology in the therapy of surgical disease.

Three years later he was made full professor and chief of the first Czech surgical clinic of Charles University on the death of his beloved chief, Professor Otokar Kukula. Kukula, on his death bed, requested that the University regents name this young and energetic surgeon to be his successor, for he believed that Jirasek would carry Czech surgery to greater accomplishments. This belief was soon realized. To work with him, Jirasek chose young energetic men interested in surgical research. Contribution after contribution followed, so that in a period of a few years hundreds of surgical papers were published. Of these to date, he alone has contributed about 150 on general surgery and some 50 papers on neurosurgery—a field of surgery that he has been developing in his country for the last 20 years. His other works are four surgical books, 15 critical studies and medical biographies and eight monographs on surgical hospital development and on surgical nursing at home and abroad. Of great interest are some 80 papers on surgical physiology and surgical demonstrations, that appeared in the Czech medical literature from 1919–1939. Each year until 1939, he rendered a detailed report of the International Surgical Society meeting, of which he was the only member from his country. Scores of popular addresses to the Czech laity, broadcast by radio, have been made by him on the important matter of the relationship of the surgeon to his patients.

He is President of the Czechoslovakian Surgical Society; Membre Academie du Chirurgie, Paris; Member, Post Graduate Assembly of North America, and Founder Fellow and Trustee of the International College of Surgeons, of which he was the first president.

In 1939, when the lights went out in Europe because of Nazi invasion, Jirasek's clinic was taken over by the invaders. The University and other cultural activities were forbidden, and Czech medical literature ceased to exist. Jirasek, however, was allowed to reorganize a hospital and clinic. Teaching or research, however, was not permitted, but the Czech spirit survived. With determination and hard work a hospital was reorganized and re-equipped, only to have it destroyed with the loss of 10 per cent of its personnel in the Allied bombing of Prague in 1945. Because of his popularity as a national leader, Jirasek was forbidden to speak with students during the entire period of occupation. Constant watch, persecution and inquisitions continued, and a good portion of his property and library were confiscated.

This was attested to by the letters that came by way of the underground from this unhappy land of the Czechs; they also mourned the loss of intellectual contact with the rest of the world.

Since the close of the war, Jirasek has rebuilt his clinic and hospital, and is hard at work making up for lost time. Bridging this vacuum of six years in Czech surgical culture, the work of the American medical teaching mission sent to Czechoslovakia last year, together with numerous modern medical books and periodicals, have so enabled him and his colleagues to study modern surgery, that already a number of new contributions have appeared from his clinic.

This year on July 3, at Prague, the Czech medical profession celebrated the sixtieth birthday of this great Czechoslovakian democrat, teacher and foremost surgeon—Professor Arnold Jirasek.

LOUIS F. PLZAK

Czech Surgery

Development of the First Czech Surgical Clinic*

The development of Czech surgery had its initiation with the foundation of Charles University in Prague in the year 1348 by King Charles IV, after whom the university was named. The university was democratic in its purpose and, as part of a wide program of higher education, tuition was free and available to everyone. This attracted numerous students and teachers from all Europe. For almost three centuries the university prospered, until in 1619, after the battle of White Mountain, it came under Hapsburg domination and lost its identity as the center of Czech culture and tradition. This condition lasted for three centuries. Jesenius (Jesinsky), the great surgeon of that time, was one of the prominent Czech leaders who were tortured and put to death by the conquerors in the hope that Czech culture might not survive. Not until 1882 did the Czechs regain partial national rights. One of these was the reopening of the Czech University, staffed by Czech scholars.

Until that time Czech surgery had no way of establishing its identity, as all teaching and scientific publication were done in the German language. Only occasional surgical writing and voluntary teaching were done in Czech by a few men, chief of these being Špott, Matějovsky and Hermann. Thus many illustrious sons of Czech origin were lost forever to Czech culture. Of the surgeons most lamented by the Czechs is Albert, who taught at the University of Vienna at that time and published most of his surgical papers in German.

In 1882, on the reopening of the Czech University, the first Czech surgical clinic was organized. It began to function and prosper under the able leadership of its first chief, Professor Weiss. Weiss' ability, courage as a surgeon and broad knowledge of anatomy soon won wide acclaim for him and his clinic from Czech students and physicians of the bordering countries. At first, Weiss devoted much of his time to the surgical problems of that time, but slowly, as the practical aspect of surgery took more and more of his time, surgical research was abandoned, so that, at the end of his regime, it was all but ended. Conservatism, lack of enthusiasm and even a loathing for surgical innovations from the German schools, were some of the reactions that prevented him and his clinic from going forward. Abdominal surgery was a forbidden domain in his clinic, while in Vienna Billroth inaugurated and performed successful gastric resections. The Czech surgical clinic during Weiss' closing days retrogressed, while the German clinic in Prague under Gussenbauer forged prominently ahead.

* Hrst Zpomínek. Čás. lek. Čisk. A. Jirasek. 1925. 64.

Into such a state of affairs, in 1891, the Czech surgeon, Karel Maydl—who was later to carry Czech surgery to continental fame—came to assume the second leadership of the Czech clinic vacated by the death of Weiss.

Maydl, with his vast war experience of 1878, foresaw numerous important problems in surgical research. As a student of Albert in Innsbruck, he had had much opportunity to do research. This opportunity, together with good training, broad vision and knowledge of Billroth's work, inspired him to become one of the modern surgeons of his time.

As chief of the Czech surgical clinic, he came at a time when antisepsis and asepsis were permitting surgery to enter newer fields. In France these were championed by Terrier and Vinay; in Germany by Kümmel and Schimmelbusch, in England by Lister and earlier by Semmelweiss in Vienna and Holmes in America. Maydl's inaugural address as chief is significant in that his subject dealt with "The Effect of Antisepsis on the Development of Modern Surgery." He introduced and emphasized pathologic physiology, thus remaining ever loyal to the influence of his great teacher, Albert. As a result of this, numerous scientific works in this field followed. Maydl was the first Czech surgeon to perform surgery on the gallbladder, and in 1897, at the Moscow surgical conference, he proposed the transperitoneal method of drainage of retroperitoneal suppurations. That year he published a treatise on subdiaphragmatic abscesses and a text book on surgery, in which the first chapter deals with hernia. His best known contribution, for which alone he earned fame, is his method of colostomy. This requires the exteriorization of a complete loop of colon. It was the first workable colostomy to be devised. Further progress of the clinic was unfortunately suddenly stopped by his untimely death in 1903.

In 1904, Otokar Kukula, a student of Maydl, became the third chief of the first Czech clinic. In full possession of a complete knowledge of the ideas and plans of his brilliant predecessor, he and his staff continued the program and added greatly to the advancement of Czech surgery. Improvement of surgical technic and emphasis on the importance of continued and detailed clinical observations to establish definite indications for surgical intervention formed the basis of the surgical work at his clinic. His extensive work on appendicitis in 1912 cited in detail the world literature on the subject and paid tribute to the classic work of Fitz on the etiology and surgical pathology, to which he added his own tremendous experience with the disease. Kukula's work on the diagnosis of surgical diseases of the liver and pancreas and his theory of the cause of acute pancreatitis by reflex of bile due to common duct occlusion by stone or edema appeared in 1918 and is significant. Experimental work done by him on intestinal obstruction led him to ascribe the toxic effects to auto-intoxication of absorbed lethal products in the occluded loop. The early effects of ileus, he observed, were not due to toxins but rather to some reflex nervous disturbance. He ascribed bleeding into the strangulated bowel lumen to be due to the effects of venous occlusion. In his work on extensive resections of the small intestine, he demonstrated that the organism can well stand removal of over half of the total length without damage to health.

Surgical treatment of diseases of the kidney and bladder won for him continental recognition. Suture of the bladder, nephrotomy for pyohydronephrosis, the role of pyocyaneus bacteria in urinary infection and studies on the histology of renal stones were some of his other contributions to urology.

To the end of his career he defended gastro-enterostomy as good surgical procedure for treatment of peptic ulcer. In his inaugural address as chief of the clinic, he emphasized the importance of team work between surgeon and internist and was ever aware of the interdependence of surgery and internal medicine as serving the best interests of the surgical patient. His war experience of injuries to the brain and spinal cord might well mark the first attempt of Czech surgery to apply itself to neurosurgery. Likewise his experience with suture of the injured heart, often quoted in historical medical reviews, marks the earliest attempts at

cardiovascular surgery. His last work, in manuscript form, was left unfinished because of illness which led to his untimely death in 1925.

In 1927, the man in whose honor this issue of the JOURNAL is published, Professor Arnold Jirasek, became the fourth and present head of the first Czech clinic of Charles University. Two Czech surgical clinics of Charles University now existed, the second one having been formed shortly after the regime of Maydl.

Jirasek, well trained by his predecessor, Kukula, continued to expand Czech surgery and added to the fundamental studies of anatomy and pathology those of careful diagnosis, finer technic and application of physiology and the other basic sciences. At his clinic, surgery of the gastro-intestinal tract is commonplace and is carried out with a mortality rate which compares favorably with that of the better clinics of Europe. Surgery of bones, muscles, tendons and joints—particularly for conditions incidental to sport activities—are studied especially. Because of the high incidence of infections of the hand and injuries to the soft parts of the knee, tremendous experience has been gained and exhaustive studies made by him and his clinic. Complete texts have been published on these subjects. Numerous contributions have been made to other fields such as surgery of the neck, especially goiter, surgery of the breast, chest wall and pleural cavity—the last for tuberculosis and pyogenic empyema—surgery of the abdominal wall (hernias), stomach, intestinal tract and subdiaphragmatic abscess.

For the past 20 years, until the military occupation of the country in 1939, Jirasek's principal emphasis has been on the development of a Czech school of modern neurosurgery. He was succeeding in this task, as is shown by the amount and variety of work done, with steady reduction of mortality and improvement of end-results.

Unfortunately, during the war years 1939–1945, Nazi occupation forbade all cultural activities. All work at the clinic stopped, and the clinic like the university ceased to exist. In spite of this intellectual vacuum of six years and with no contact with world progress in medicine and surgery during this entire time, two years ago this clinic was reorganized under Jirasek and is functioning again, producing scientific papers and carrying on research.

With the help of modern facilities provided by America, England and Russia—books, periodicals and equipment—and with the further aid of the American teaching missions and the instruction of some prominent Czech surgeons who are at present studying at our large clinics and Universities, Czech surgery is rapidly being brought up to date.

With the will and intelligence so characteristic of the Czechs, Czech surgery under the able, courageous and driving leadership of Professor Arnold Jirasek, will rise to take its proper place in the world of international science.

L. F. PLZAK

Original Articles

The Neurosurgical Team

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THE day of the brilliant solo operator is passed, and in his place has come the surgical team. The surgical team is part of the larger medical team, that channels the patient into the hands of the proper group to deal with his particular condition. In order to insure adequate care, it may be necessary to have various combinations work on him. Curiously, this seems to coincide with the trend of the time in other matters, in which the individual is submerged into a group and the group is submerged into a plan. Some one, however, must steer the patient through the various departments and must be ready to make decisions as to the course to be followed.

Neurologic surgery is now a long way from the day when the general surgeon trephined the skull at a certain spot under the direction of the neurologist. The specialty is now so diffuse as to spread itself into many allied branches of medicine and surgery, and today exemplifies the keynote of team work. This has come about gradually, partly by brilliant investigative work on the part of neurologic surgeons, partly by the work of their medical colleagues and partly by the efforts of scientists in allied fields. The certainty is that today the successful neurologic surgeon must bring his team into consultation with many other groups in the field of medicine. This is, of course, an entirely mutual affair and reacts to the benefit of all.

The first advances in the surgery of the nervous system were entirely solo work and great names can be mentioned, such as MacEwen, Horsely, Cushing, Dandy and a host of fellow workers. The technic of working on the nervous system was developed by Cushing and was more or less solo work. Fortunately for him, he had been a student of Halstead, whose meticulous treatment of tissues at operation was a byword. Cushing exemplied to the full the ultimate achievement of the brilliant operator, the thorough diagnostician and the clinical investigator. Refinements in diagnostic technic were sure to follow. Walter Dandy made an epochal contribution, when he introduced ventriculography and encephalography in 1919.[1] This introduced an element of team work—the roentgenologist, who, up to this time, had been called upon only to review flat plates of the skull, now found himself concerned with the intimate knowledge of the nervous system. To one branch of this field, encephalography, the work of Cornelius Dyke[2] is sufficiently noteworthy to be of interest to all in the specialty. The introduction of the Bovie-Davis electrosurgical unit in 1927 illustrates the contribution of allied scientists to the subject. This great technical advance was taken up and further developed by Harvey Cushing,[3] so that today the neurosurgeon would rather operate without a knife than without an electrosurgical unit. These two great advances in neurologic surgery were not accepted by all with equal enthusiasm. Some thought that ventriculography would spoil the clinical acumen of the medical man and relegated this procedure to the laboratory test group. Others pointed out the high mortality rate of ventriculography and suggested other drawbacks. All these difficulties were overcome when it was realized that ventriculography indicating a space-occupying lesion must be followed immediately by craniotomy and partial or complete removal of the lesion. Even this simple and now accepted procedure requires close cooperation between the surgical team and the operating room personnel, the x-ray personnel and the roentgenologist. The reports of Lysholm,[4] working on the patients of Olivocrona in Stockholm, are

clearly illustrative of the point I wish to make. The roentgenologist is concerned in other projects of the field of the neurologic surgeon, especially those concerning opaque media. Lipiodol fluoroscopy, though far from harmless, requires the assistance of the roentgenologist, but also the use of his technical equipment. Here again, it is important for the surgeon to be present, to understand the problem under investigation and to make the decision as to how to proceed. The irritating effects of lipiodol led to a search for another opaque contrast medium, pantopaque, which was developed under the supervision of Glen Spurling. This substance, though not quite so satisfactory to handle in some respects, has the advantage of being relatively nonirritating and of being removable from the spinal canal immediately after its use. One cannot omit mention of arteriography, first introduced by Moniz, and now being used extensively in various clinics. Percival Bailey of the Illinois Neuropsychiatric Institute has been actively interested in the use of arteriography, especially in an attempt to separate the glioblastoma from the neoplasms of the cerebral hemispheres. The correlation of the arteriographic picture and the histologic diagnosis is progressing with increasing accuracy, and it is hoped that later many rather useless operations for glioblastoma and for multiple metastases will be avoided.

To return to technical neurosurgical advances that concern mainly the surgeon, it is necessary to mention the position of the patient. There are still some clinics at which nearly all operations on the nervous system are carried out in the recumbent position. They are, I believe, in a gradually increasing minority. The sitting position has been in use for over 30 years in the operation of retrogasserian neurectomy for trigeminal neuralgia, and most neurologic surgeons would refuse to contemplate the operation in any other position. Operations on the cerebrum and cerebellum in the sitting position were introduced in Europe by de Martel [5] and in America by W. James Gardner [6] of the Cleveland Clinic. Although I cannot agree that operations on the cerebral hemispheres are facilitated by the upright position, I cannot be too enthusiastic about this position for cerebellar operations, high lamnectomies and high thoracic sympathectomies by the posterior approach. The operation for complete removal of an acoustic neurinoma is tremendously facilitated by the upright position. It is an advantage to have the legs up and at right angles to the body in order to maintain blood pressure. The cooperation of the instrument maker will be helpful in devising a rig to hold the cerebellar head rest to accommodate this position. Winchell McK. Craig [7] of Mayo Clinic has devised a head rest, which is easily portable and which can be made to fit any standard operating table. Various head rests have been devised for ventriculography in the upright position. The additional time necessary to obtain the position is fully compensated for by the more satisfactory filling of the ventricular system.

Another technical improvement in the surgery of the nervous system is the introduction of the hemostatic agents, such as fibrin foam, developed by Frank Ingraham [8] and the group at the Massachusetts General Hospital, and gelfoam, developed by Richard U. Light [9] and the Upjohn Company. My experience is entirely limited to gelfoam, which has proved invaluable under certain conditions. Fincher [10] has recently discussed its uses in some detail. I have found gelfoam useful in the crater of a meningioma or a glioma, next to the pons, after removal of an acoustic neurinoma, against the cavernous sinus in the operation for trigeminal neuralgia and on the epidural veins in cervical and lumbar protruded intervertebral disks. The method of its application in experimental surgery has been carefully discussed and investigated by Jenkins.[11]

Mention should be made of an additional useful technic in ventriculography, namely the introduction of a ventricular catheter. I believe this was first described by Poppen [12] of Lahey Clinic. A catheter is introduced into the noncollapsed ventricle, at the time of ventriculography, and to it is attached a soft transparent bag. An ordinary condom is usually used. The catheter is fixed to the scalp with sutures, and the catheter is pinched with silver clips or kinked, to prevent the air

from escaping into the bag. After ventriculography the silver clips are removed, and while the operation is in progress, this, the dependent ventricle of the uninvolved hemisphere, drains air and spinal fluid into the bag. A beneficial effect is thus maintained on the increased intracranial pressure during and after the operative procedure. It may save a hemiparesis or an aphasia, and certainly promotes a much more satisfactory immediate convalescence. The catheter and bag may be left in for three or four days, both kept under sterile conditions. The bag is occasionally tapped when it becomes too full.

From a purely technical standpoint, chemotherapy has done a great deal for neurosurgical technic, and it is hoped that it will not promote slight technical carelessness. Before chemotherapy, the slightest infection in or around the nervous system was a matter of the most serious consequence. Wound infections, no matter how slight, were looked upon with greatest anxiety and were usually the subject of a full-scale investigation. Deaths from this source are now happily few and far between, as are deaths from postoperative bronchopneumonia, which can also be controlled by chemotherapy.

Careful technic and careful cooperation in the nursing of neurosurgical patients will make the use of chemotherapy relatively infrequent, except in cases of infection of the nervous system. In my practice, brain abscess is now a relatively rare clinical condition, and, when it does occur, it seems to be much more easily handled than formerly. The use not only of chemotherapy, but of penicillin [13] has contributed to this happy state. With these two useful adjuncts in the control of infection, there is a progressive tendency to deal more radically with brain abscesses, and their liberal use makes it possible to deal with acute and even multiple contiguous abscesses. Operations have recently been described, in which acute abscesses have been sucked out and the area of the brain exposed at operation brought in contact with penicillin; this combined with intrathecal, intraventricular penicillin and chemotherapy has brought these hitherto hopeless cases to a successful conclusion. Chronic abscesses have been drained and filled with penicillin solution and then completely removed by craniotomy. The mortality rate of various forms of meningitis has been revolutionized by cooperation between the neurologic surgeon and the pediatrician. Penicillin, however, is not a harmless drug, and its use especially intrathecally cannot be indulged in with abandon. A. E. Walker [14, 15] and his associates at the University of Chicago have thoroughly discussed this subject.

The pathologist plays an important part in a good neurosurgical set-up, but he must be a trained neuropathologist; furthermore, I believe he should have thoroughly familiarized himself with the classification of gliomas described by Bailey and Cushing.[16] This is so universally used that any other renders one incommunicado as far as other neurologic surgeons are concerned. This classification has, of course, the advantage of giving a rather clear idea of the life history of the tumors under discussion. The pathologist should also familiarize himself with the gliomas as they appear stained after frozen section. This is of the utmost importance to the surgeon at the operating table, as he should certainly make every effort to extirpate the relatively nonmalignant gliomas completely. Pathologists, like surgeons, have a tendency to be individualists, but in this regard they should try to curb their ideas for the ultimate good of the patient. It is well if the surgeon is not completely unconversant with the histologic picture of these tissues himself, but in many cases he has to rely immediately on help from others.

The ophthalmologist has come into intimate relationship with the neurologic surgeon, not only in the examination of the visual fields, but also of the fundi. The contribution of Walker [17] and Ivan Lillie [18] to the localization of lesions of the nervous system are outstanding. The usefulness of the ophthalmologist varies with his experience of neurosurgical conditions. The surgeon gets used to his method of taking and charting fields as well as to the language in which he describes them. Thus a relatively young and unknown confrère may be much more helpful than one nationally known. It is more important to be thorough than smart, and it is important to

understand and interpret the subjective reactions of the patient. The only alternative to this is confrontation perimetry,[19] in which the patient draws his own visual field. This, however, has a rather limited application. The importance of accurate visual fields cannot be overestimated, for they are the most reliable localizing signs available. In the event that the field signs are at variance with the others, accept the fields and reject the others. Lately, the ophthalmolgist has been of assistance to the neurologic surgeon in interpreting the fundi of patients with hypertension, and, indeed, some classifications of this disease depend heavily on the fundus picture.[20] Here again, one ophthalmologist who understands the problem can be of much more help than any number of good ophthalmologists. Continuity of ideas is essential for interpretation of opinions.

Since the development, by Freeman and Watts,[21] of the operation of lobotomy just used and described by Moniz,[22] the psychiatrist has become much more closely allied with the neurologic surgeon. Hitherto, occasional functional cases and organic dementias were the meeting ground, but now with psychosurgery definitely on the upswing, there is a large contiguous field of activity. It is estimated that carefully controlled and carefully performed lobotomy will greatly reduce the inmates in our asylums, and incidentally greatly reduce the economic burdens of these institutions.[23] The selection and evaluation of cases are the important factors, and here again continuity of ideas is essential. Different psychiatrists have shown such divergent approaches to even the most fundamental problems, that the neurologic surgeon would do well to try and work exclusively with one man or a closely knit group.

Mixter and Barr [24] first discussed and drew attention to the syndrome of the herniated or protruded intervertebral disk. Since then, the syndrome has been studied by other neurologic surgeons, notably Bradford and Spurling,[25] and Love.[26] The technic of removal of the offending disk was simplified and improved, so that it became a relatively simple procedure. As time went on, however, it became apparent that simple removal of the disk for sciatica was not always sufficient, and that many of these patients had continued instability of the back and backache. The backache could be relieved by spinal fusion, which introduced the orthopedic surgeon. It is now our practice to see all such cases together, and to decide what procedure is to be adopted. All fusion cases are combined operations with the orthopedic team. Thus the patient obtains the best result, by having the neurosurgeon take care of the disk or neurologic lesion and the orthopedic surgeon the unstable back. The operating time is cut down, and the efficiency of both procedures is improved.

The operations on the sympathetic system call for close contact between various groups: those for hypertension with the medical group and those for peripheral vascular disease with still another group. The use of tantalum in the repair of cranial operative defects has not been mentioned, although every one is aware of its use in the surgery of warfare, but not so clear as to its use in civil practice.

I have purposely left until the last a few remarks on the surgical team. All of this personnel has a special function, which can only be accomplished satisfactorily by familiarity and cooperation. The surgical nurse must be an old hand and familiar with every detail of the procedure; constant practice is the only thing that can produce this. There is a tendency among hospital authorities to think that one nurse is as good as another. A strange nurse can ruin an operative procedure, as can any unfamiliar person in the operating room.

The anesthetist is in a special classification, for he plays such an important part. Any qualified anesthetist can do the work, especially when he gets used to it. I do not believe any anesthetist can give a satisfactory anesthetic for a brain case without practice. As in most subjects, there is no such thing as a heaven-sent genius. Here again there is a tendency for hospital authorities to think that any anesthetist can give any anesthetic; this is entirely wrong. The various members of the team must become used to one another, and after a time everything goes smoothly. Practically every anesthetist I have had, has been excellent after about a month or six

weeks; before that time, they were a source of anxiety and apprehension. Some of this is due to the choice of anesthetic, and this in itself is limited because of the use of the electrosurgical unit. The best anesthetic would be some form of natural sleep, which is so far unavailable. It has been our custom to use avertin, tribromethanol with amylene hydrate as a basal anesthetic. This is given in the patient's room and eliminates the fear of the preliminaries to the operation. In the operating room, the anesthetic is maintained by intratracheal nitrous oxide and oxygen. In other clinics sodium pentothal is used almost exclusively, and in capable hands this can be a very satisfactory anesthetic. Constant practice makes perfect with almost any medium. In our operating room the anesthetist gives intravenous solutions and blood. Soon the most difficult cases can be handled without effort by a well coordinated team.

More and more neurosurgery will be done, and everywhere neurosurgeons are graduating from their apprenticeship into responsible positions in various communities. The work is highly technical and is definitely not a one-man job, though one person must direct and synchronize it. The neurosurgeon must gather round him a team that he understands and which understands him. At least one member of the neurosurgical team must be a constant inmate of the hospital where the work is done. The operation is only one of the steps in the care of the patient, and a constant system of preoperative and postoperative care must be established. Casual operations in distant hospitals, where neurosurgically trained personnel is not available, should be reserved for serious emergencies and minor cases. Even so, lack of necessary equipment may be more of an adverse factor than the transportation of the patient to the equipment. Many of these points were clearly brought out during the war by establishing neurosurgical centers, which turned out such an excellent quality of work as to make one wonder what would have happened without them. The accomplishments of these neurosurgical centers with their team work is only beginning to be appreciated; fortunately, those in authority were sufficiently far sighted to make them possible. Private and semiprivate practice can be similarly modified to obtain these advantages without sacrifice of the individual liberty of the medical men involved.

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The Clinical Significance of Proteins and Amino Acids in Surgery*

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THE concept of protein deficiency as a factor in disease is relatively new. It is true that Voit and others in the last century had recognized the need of an adequate protein intake for proper nutrition. But none of these early investigators visualized any connection between such requirements and the development of clinical symptoms of protein deficiency. It was not until 1917 that Epstein [1] offered the now firmly established theory that the edema found in certain types of kidney disease—the so-called nephrotic syndrome—was due to the loss of serum protein in the urine. His recommendation of a large intake of protein in such cases is probably the first instance of the therapeutic use of high protein diets.

Even Epstein at this time probably had no real understanding of the relation of the loss of serum protein to the development of a generalized protein deficiency. A high protein diet was necessary merely to replace the large losses of serum protein in the urine. The fact that hypoproteinemia was only part of a general loss of protein from the tissues as a whole became clear from the studies of Madden and Whipple.[2] That such hypoproteinemia with its associated general tissue protein deficiency occurred in many conditions other than those with severe loss of protein in the urine was first recognized during the first World War in the phenomenon of famine edema and from the studies of Peters and his coworkers [3] during the 'twenties. It was, however, not until the late 'thirties that the role of protein deficiency in the complications of surgery, especially in gastro-intestinal diseases, was elucidated. Among the important contributors in this field were Mulholland *et al.*,[4] Elman and Licher,[5] Kagan,[6] Radvin [7] and Casten and Bodenheimer.[8]

The adult requirements of protein in the diet are now well established. In the normal wear and tear of the body tissue, proteins are hydrolyzed to amino acids. Some of these amino acids are used over again to build new protein molecules, but a portion of them is deaminized. The ammonia formed is converted to urea and excreted. In addition, some amino acids as such are lost in the urine. Because of this relative inefficiency in the body economy, it is necessary for the adult to replace the lost protein "building-stones" by an adequate intake of protein. In normal individuals, a diet containing 1 Gm. of protein per Kg. of body weight per day is more than adequate to meet the daily requirements, especially if more than half of this amount comes from the so-called biologically-valuable proteins, namely, the proteins of milk, eggs, poultry, fish, meat and cheese. Positive nitrogen equilibrium can be achieved with much less than 1 Gm. protein per Kg., if the caloric requirements are met by an adequate intake of carbohydrate. On the other hand, when the diet is calorically insufficient, intake of even more than 1 Gm. of protein per Kg. may not produce nitrogen equilibrium, since a greater portion than usual of the amino acids will be deaminized and the deaminized moieties used up as sources of energy.

Protein deficiency occurs in a large variety of circumstances, most of which should be obvious but which are often forgotten in the evaluation of the clinical condition of a patient. Among the important mechanisms producing protein deficiency are the following:

1. Decreased dietary intake of protein, as in famine, poverty, voluntary dietary restrictions, obstructive conditions of the gastro-intestinal tract,

* Some of the material in this paper was presented before the Division of Medicinal Chemistry, American Chemical Society, Sept. 11, 1946.

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pre- and postoperative starvation, anorexia and repeated vomiting.

2. Decreased absorption of protein, as in cancer of the stomach, pancreas or liver, diarrhea or dysentery, ulcerative diseases of the intestine and conditions associated with diversion or absence of pancreatic juice or bile from the intestine.

3. Decreased formation of blood proteins, as in diseases of the liver in which organ albumin and fibrinogen are believed to be formed, and involvements of the reticulo-endothelial tissues of the body where globulin is said to be produced.

4. Increased loss of proteins as in kidney diseases; burns, in which protein-rich exudates are lost from the surface of the wound; hemorrhage, draining sinuses or abscesses; excessive vomiting or diarrhea; suction drainage through Levine tubes; paracentesis, abdominis and thoracis; breakdown of necrotic tissue in the course of infections, cancers or surgical operations.

5. Increased requirements of proteins as in hyperthyroidism, fever, pregnancy and leukemia.

Proteins are essential to all protoplasm, and are involved both in the maintenance of the structure of the cell and in its enzymatic metabolism, since enzymes themselves are proteins. Many of the hormones are proteins; others may be associated with proteins in their activity. The vital activity of the blood

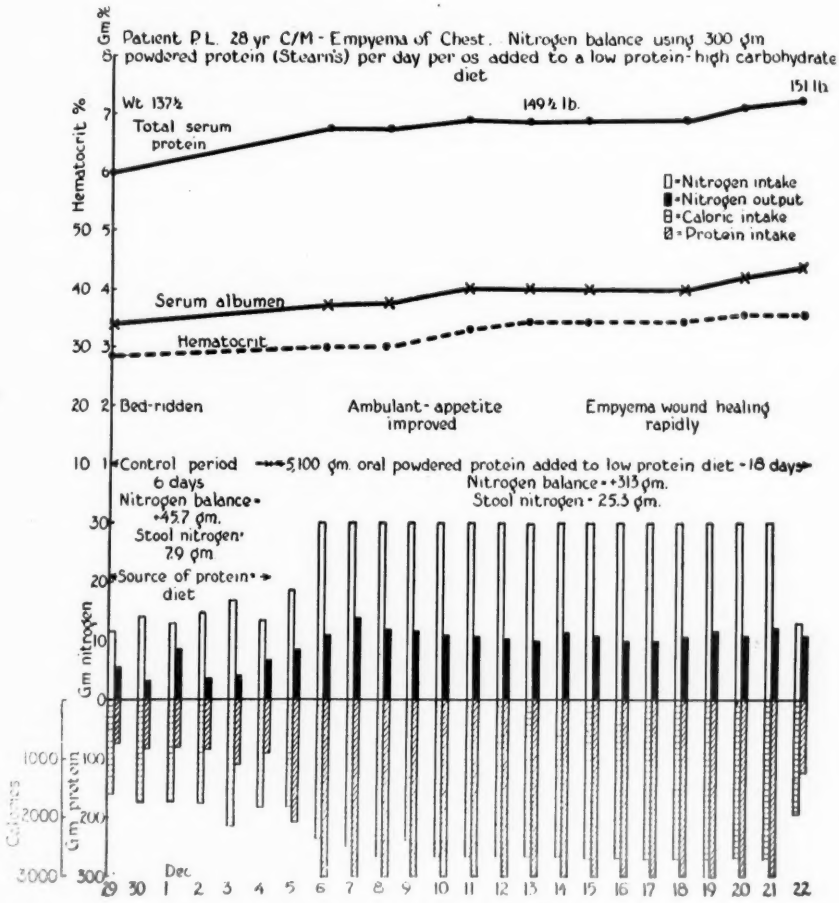
Patient P L. 28 yr C/M - Empyema of Chest. Nitrogen balance using 300 gm powdered protein (Stearn's) per day per os added to a low protein-high carbohydrate diet
Gm %
Hematocrit %
Wt 137½
149½ lb.
151 lb
Total serum protein
Nitrogen intake
Nitrogen output
Caloric intake
Protein intake
Serum albumen
Hematocrit
Bed-ridden
Ambulant - appetite improved
Empyema wound healing rapidly
Control period 6 days
Nitrogen balance - +45.7 gm.
Stool nitrogen - 7.9 gm
5,100 gm. oral powdered protein added to low protein diet - 18 days
Nitrogen balance - +313 gm.
Stool nitrogen - 25.3 gm.
Source of protein - diet
Gm nitrogen
Calories
Gm protein
Dec.
29 30 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

Fig. 1.—Nitrogen balance studies in patient with severe protein deficiency, who was given large quantities of oral powdered protein (essenamine). (Reprinted by permission of *Archives of Surgery.*)

is maintained by proteins: the control of O_2 and CO_2 through hemoglobin and the enzymatic proteins of the red cells; the homeostatic control of the volume of the circulatory blood and that of the interstitial fluids through the plasma proteins; blood clotting through thrombin, fibrinogen and other plasma protein factors; the defense against infection by means of antibodies now believed to be in the gamma globulin fraction of the blood. Thus all biologic processes depend upon the maintenance of a proper quantity of the various proteins. Protein deficiency will then ultimately manifest itself in a deterioration of all bodily functions and eventually, of course, in death.

There are specific clinical effects of protein deficiency that are important not only because they aid in the recognition of the deficient state, but also because they permit an understanding of the clinical problem of the associated medical and surgical condition. The most important of the symptomatic manifestations of protein deficiency are the following:

1. Peripheral edema. The quantity of the interstitial fluids is maintained constant by a balance between osmotic pressure of the plasma proteins and the hydrostatic pressure of the blood in the capillaries of the body. When the quantity of fluid filtered through the capillaries at the arterial end continues to be greater than that which is absorbed back into the capillaries at the venous

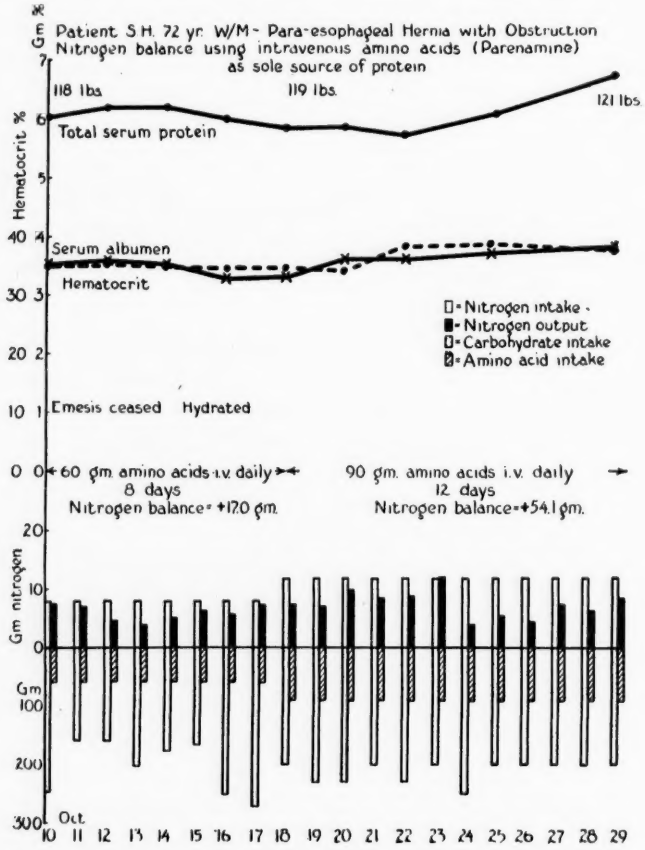

Fig. 2.—Nitrogen balance studies in patient receiving parenteral amino acids as only source of protein. Positive balance obtained with 60 Gm. intake. (Reprinted by permission of *Archives of Surgery*.)

end, an accumulation of fluid occurs in the extracellular spaces of the tissues which, when clinically demonstrable, is called edema. This condition occurs under several circumstances, one of which is that in which the serum protein concentration has been appreciably reduced. The common sites of the edema are the dependent portions of the body and the regions of low elastic tissue pressure. In the former, the tendency to edema is enhanced by the increased hydrostatic pressure; in the latter, by the lack of resistance of the tissues. This type of edema occurs in most severe form in conditions associated with large losses of serum proteins in the urine, but may be seen in other kinds of protein deficiency.

2. Visceral edema, involving the lungs, intestines and other organs. Such edema is potentially more dangerous than that found in the regions under the skin.

3. Obstruction, partial or complete, of the intestine at the site of stomata because of edema of the bowel wall.

4. Diminished gastro-intestinal motility because of edema of the bowel wall, leading in moderate cases to distention, in severe cases to paralytic ileus.

5. Delayed wound healing, because of protein deficiency and because of edema of the wound surfaces. In surgery, postoperative evisceration has been found to occur on this account.

6. Liver damage and greater susceptibility of the liver to intoxication by drugs.

7. Increased susceptibility to infection. It has been shown by Cannon [9] and others that there is a marked lowering of the gamma globulin fraction of the plasma proteins in protein deficiency. In this fraction reside the plasma antibodies. Cannon has been able to demonstrate the diminished development of specific antibodies in protein deficient animals.

8. Susceptibility to shock. Since shock itself is associated with a lowered plasma volume, development of the shock condition is easier, if hypoproteinemia and its accompanying diminished plasma volume is already present.

9. Diminution or complete absence of urine associated with a diminished blood volume. Rhoads *et al.*[9a] demonstrated the difficulty of restoring normal blood volume and adequate urine flow in postoperative conditions associated with low serum protein. When saline fluids are given to such a patient, they not infrequently tend to increase the peripheral or visceral edema without producing a marked increase in blood volume and in urine flow.

10. Anemia. Whipple [10] has demonstrated the importance of protein as well as iron in hemoglobin production. Such anemia is sometimes not recognized because the patient has a diminished plasma volume.

11. Increased tendency to thrombosis and embolism. This is an indirect result of delayed convalescence and ambulation because of poor nutrition.

Recognition of protein deficiency.—Since it has been found that generalized protein deficiency is always associated with a diminution in serum proteins, the determination of the concentration of the latter has been utilized as a measure of protein deficiency. The normal serum protein concentration ranges from 6.5–8.0 Gm. of protein per 100 c.c., with an average of about 7.0. Of this 7.0 Gm., 4.5 is albumin, as determined by salting-out methods. Albumin represents the osmotically smaller molecules which play the important role in preventing edema and maintaining blood volume. Their average molecular weight is about 70,000. The rest consists of globulin which has an average molecular weight of about 165,000, and which can be separated by electrophoresis into alpha, beta and gamma fractions. Since the globulin portion tends to remain more nearly constant in protein deficiency, the determination of the total serum protein concentration has been regarded (but not always justifiably) as a measure of the albumin concentration and therefore of protein deficiency. Rapid laboratory methods have been worked out for the estimation of serum protein concentration by determining the rate of fall of a drop of serum through a column of liquid of known specific gravity, based on the proportionality of the specific gravity of serum to the concentration of protein. This phenomenon is the basis of the method of Barbour and Hamilton [11] and of Kagan.[12] Another similar method is that of Van Slyke,[13] in which the direction of movement of a drop of serum allowed to fall into a solution of copper sulfate of varying specific gravity is determined. The specific gravity of the serum is equal to that of that solution in which there is no immediate upward or downward movement. The classical chemical method for the determination of serum protein is of course the Kjeldahl method, with

volumetric or colorimetric determination of the formed ammonia. Albumin is determined in a filtrate of serum after addition of the proper concentration of ammonium sulfate, sodium sulfate or sodium sulfite to salt out the globulin fraction.

Because the concentration of protein may appear to be greater than it actually is in the presence of a diminished plasma volume (since the total amount of circulating water is diminished), protein deficiency may not be unmasked by a determination of the serum protein concentration. It may be necessary to ascertain the total circulating protein by determining the plasma volume by one of the dye methods and multiplying this volume in cc. by the concentration of protein in Gm. per cc. The average person weighing 70 Kg. will normally have about 50 cc. of plasma per Kg., or a total of about 3,500 cc. The total circulating protein in such an individual will be 3,500 x 0.07 or 245 Gm. In dehydrated individuals with protein deficiency, Abbott and Mellors [14] have found that that though the protein concentration may be 6.5 Gm. per 100 cc. (which appears to be normal), the actual plasma volume may be only 2,100 cc., and the total circulating protein thus only 136.5 Gm., or less than 56 per cent of normal.

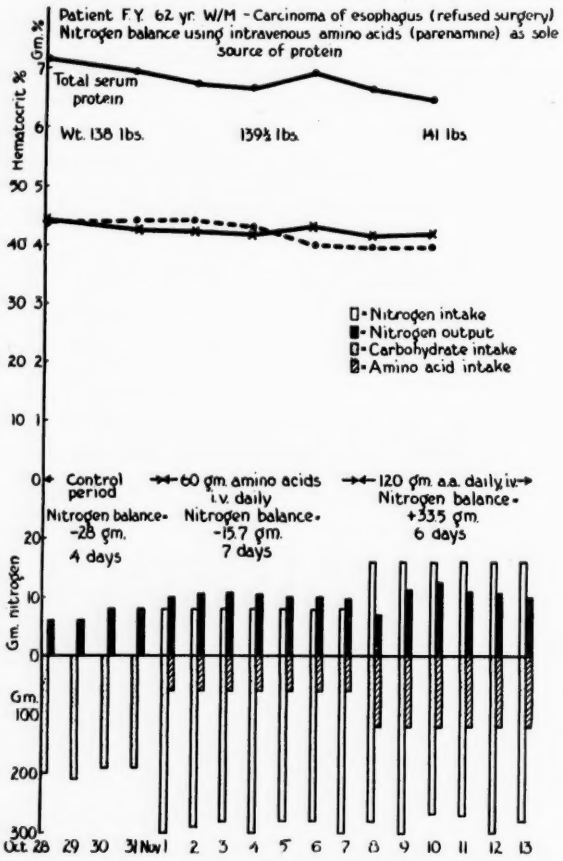
Patient F.Y. 62 yr. W/M - Carcinoma of esophagus (refused surgery)
Nitrogen balance using intravenous amino acids (parenamine) as sole source of protein
Gm.%
Hematocrit %
Total serum protein
Wt. 138 lbs.
139½ lbs.
141 lbs.
Nitrogen intake
Nitrogen output
Carbohydrate intake
Amino acid intake
Control period
Nitrogen balance- -28 gm. 4 days
60 gm. amino acids i.v. daily
Nitrogen balance- -15.7 gm. 7 days
120 gm. a.a. daily i.v.
Nitrogen balance- +33.5 gm. 6 days
Gm. nitrogen
Gm.
Oct. 28 29 30 31 Nov. 1 2 3 4 5 6 7 8 9 10 11 12 13

Fig. 3.—Nitrogen balance studies in patient receiving parenteral amino acids as only source of protein. Negative balance on 60 Gm., but excellent positive balance on 120 Gm. (Reprinted by permission of *Archives of Surgery.*)

The weight loss in a person with malnutrition may be used as a guide to the total protein loss. If the formula derived empirically by Lusk [15] in his study of starvation can be applied to clinical malnutrition, namely 30 Gm. of nitrogen for every Kg. of weight lost, then a patient with cancer of the esophagus who has lost 15 Kg. will have a body protein nitrogen deficiency of 450 Gm. The recognition of such a quantity is important, for, as will be shown further, a so-called successful program of protein restitution might produce a positive nitrogen balance of 4 Gm. a day. Such a program would require 113 days for complete recovery of lost tissue proteins. Elman [16] has estimated that for every 31 Gm. of new protein formed in a patient treated for protein deficiency, 30 Gm. appears as tissue protein and only 1 Gm. as serum protein. If this formula is correct, then the patient who had 136.5 Gm. of total circulating protein instead of a normal of 245, would need, in order to restore the lost 108.5 Gm. of serum protein, to retain a total of 31 x 108.5 or 3,363.5 Gm. of protein, the nitrogen of which, on the basis of 16 per cent, is 538 Gm. This value is of the same order as that determined by the Lusk formula.

Treatment of protein deficiency.—Obviously the treatment of protein deficiency is a diet high enough in protein to produce a markedly positive nitrogen balance. This should be done prophylactically, whenever possible, for it is usually much easier to prevent protein loss than to make restitution for it. In surgical cases, the large inevitable postoperative losses of nitrogen may be anticipated by a high protein diet and large transfusions of blood before and immediately after operation. In actual management of cases in which the deficiency already exists, the diet should be as rich in protein as possible. With the ordinary foods, it is possible to give as much as 125 Gm. of protein daily, if the patient's gastro-intestinal condition permits the large bulk, and especially if milk and cheese are well tolerated. In such diets, it is desirable to limit the fat, if possible, and to utilize those vegetables and fruits that are high in carbohydrate and low in bulk.

In most cases of protein deficiency, even if the patient is able to take food orally, the limitations of appetite and volume capacity of the stomach make a high intake of natural protein food impossible. In such cases it is advisable to incorporate in the diet concentrated protein foods such as dried whole milk, soybean flour, peanut flour and dried brewer's yeast. With the judicious use of such protein stretchers, it is possible to increase the protein content of the diet considerably without marked increase of the bulk of the diet. We [17] have been particularly successful in the utilization of a new powdered protein especially prepared from lactalbumin (Essenamine, kindly furnished by Frederick Stearns and Company). In a series of 14 cases of protein deficiency in surgical patients, we have found it possible to administer as much as 30 Gm. of nitrogen daily, most of which came from the Essenamine incorporated with the regular diet. The daily positive nitrogen balance in these cases ranged from 6–20 Gm. of nitrogen, with an average of 12 Gm. These patients demonstrated marked increases in serum protein concentration even while the plasma volume was increasing and showed an improvement in general well being. The results of one such case are shown in Figure 1.

Amino acids in the form of protein hydrolysates can at times be administered orally or through an intranasal catheter into the stomach to furnish large quantities of protein nitrogen. Co Tui and his coworkers [18] have been eminently successful in the use of this form of alimentation in the treatment of peptic ulcer. They were able in cooperative patients to administer as much as 400 Gm. of amino acids along with glucose by the intranasal route. The limitations of this method are the requirement of complete cooperation of the patient, the annoyance of the intranasal catheter, the danger of esophagitis, the psychologic disadvantage of the unnatural dietary management and the frequent association of nausea, vomiting and diarrhea produced by the high concentration of osmotically active crystalloids in the gastro-intestinal tract.

The Use of Parenterally Injected Amino Acids.—It is now well recognized that many patients with protein deficiency are unable to take sufficient quantities of proteins by

mouth to provide a positive nitrogen balance. Many patients, in fact, are unable to take oral alimentation at all. These often have the severest degree of protein deficiency; for example, patients with esophageal, gastric or intestinal obstruction, those with repeated vomiting from other causes and those who have just been operated upon. For such individuals the need for a parenteral source of protein has long been recognized. Up to the 'thirties, such patients could only obtain solutions of glucose or sodium chloride by either subcutaneous or intravenous injection. With the development of blood banks and methods for storage of plasma, transfusions of whole blood or plasma became a successful instrument for intravenous protein alimentation. For severe anemia and for acute loss of plasma proteins as occur in hemorrhage, burns and shock, such transfusions are of course invaluable and are often life-saving; but they are ineffective and impractical as means of restitution of severe and prolonged protein losses. Thus, 1,000 cc. of plasma furnishes 70 Gm. of protein. Even if the daily injection of such quantities (equivalent to the plasma of 4 donors) were possible, the degree of positive nitrogen balance obtained would be inadequate to achieve recovery of protein stores. Some other or additional source of protein is necessary. In 1939, Elman and Weiner[19] reported the successful intravenous injection of a protein hydrolysate into human subjects and thus inaugurated a new era in parenteral therapy. It is now possible to maintain at least for a limited period the nutritional requirements of patients by intravenous injections of fluids furnishing water, NaCl, other mineral constituents, glucose and amino acids and vitamins.

In the last eight years, the parenteral administration of amino acids has become an established clinical procedure. Its most obvious and most popular use has been in surgery, particularly that of gastro-intestinal diseases. One of the important advances in surgery of the last 15 years is the recognition of the direct relationship of the patient's state of nutrition to his chances of withstanding well the shock of the operation and the anesthetic, of resisting postoperative infection, of achieving primary closure of the operative wound and of avoiding other postoperative complications. The patient should be in water and electrolyte balance during and after the operation. This can be accomplished by the judicious administration of physiologic saline solution, with addition of water in the form of 5 per cent glucose solution before and immediately after the operation. The criteria for the quantities required are restoration of the proper tone of skin, mucous membranes and soft tissues, maintenance of normal concentration of serum chloride, sodium and bicarbonate; and excretion of an adequate quantity of relatively dilute urine. Postoperative starvation and its accompanying acidosis can be prevented by the injection of glucose solution. Anemia is corrected or avoided by large whole blood transfusions. Deficiency of vitamin B complex and vitamin C is obviated by large doses of those vitamins, parenterally if necessary. Protein deficiency is treated by injections of amino acids for as long a preoperative time as the condition of the patient allows, and for as long a period postoperatively as is required to restore the patient's ability to take adequate nourishment by mouth. Such a regimen often requires the administration of 4 L. of fluid a day, a good portion of which may be hypertonic, and which may, therefore, eventually produce thrombosis of the available veins.

Our experience with parenteral administration of amino acids at the Cook County Hospital has been founded on careful nitrogen balance studies carried out on 34 patients with protein deficiency, in whom the only source of protein nutriment was parenterally injected amino acids. In 14 patients, the product used was Prenamine,* a casein acid hydrolysate fortified with tryptophane and put up in a 15 per cent solution. In 20 other patients, the studies were made with a lyophilized casein acid hydrolysate fortified with tryptophane.† With both products it was found possible to obtain positive nitrogen balance in most patients with reasonable quantities of amino acid preparation. In

* Furnished by Frederick Stearns and Company, Detroit, Mich.

† Furnished by Interchemical Corporation, Biochemical Division, Union, N. J.

the earlier studies,[20] some patients achieved positive nitrogen balance on 60 Gm., others on 90 and still others required 120 Gm. In only one patient out of the 14 was it impossible to obtain positive balance. Similarly in the later studies, positive nitrogen balance was achieved in 19 cases out of 20. In this latter study,[21] a more thorough investigation was made of the relation between nitrogen intake and nitrogen balance. The patients' nitrogen excretion was studied during a period of zero intake of nitrogen and after progressively increasing quantities of amino acids per day, the caloric intake being kept adequate in all cases by oral and intravenous administration of carbohydrate. It was found that in these human subjects with protein deficiency, quite as Allison *et al.*[22] demonstrated in dogs made hypoproteinemic by plasmaphoresis, the nitrogen intake requirements for nitrogen equilibrium varies with the endogenous nitrogen excretion, and that the latter appears to be lower in the more chronically protein deficient individuals. More nearly constant was the slope of the curve of nitrogen balance as compared with nitrogen intake. This is a measure of the biologic value of the protein. The average value for this slope was 0.68 as compared with 0.80 for casein administered orally in dogs.[22] The average intake required for nitrogen balance was 129 mg. N per Kg. per day.

That some patients cannot be brought into nitrogen equilibrium even with high intakes of protein is now well recognized. These are usually patients with recent acute injuries such as a major gastro-intestinal operation, burns and severe trauma. This phenomenon is spoken of as the catabolic effect of trauma, in which the tissues are temporarily unable to synthesize proteins from amino acids, possibly because one or more essential amino acids are being utilized for other purposes.

In both these studies, the patients bore the regimen well and usually showed some improvement after several days. There were practically no reactions to the injections other than occasional nausea and vomiting, if the injections were given too rapidly. Studies[23] of the plasma amino acid levels during administration of the hydrolysate tended to show that nausea and vomiting were most likely to occur if the level rose much above 10 mg. per 100 cc., but this finding was not consistent. There is some belief that glutamic and aspartic acids are the causative factors in the production of vomiting. The lyophilized preparation was especially prepared so as to diminish the quantity of these acids, and possibly that is why we found that we could give as much as a 10 per cent solution at a rate of 50 to 60 drops per minute or about 25 Gm. per hour.

It was found that positive nitrogen balances higher than 4 Gm. per day were difficult to obtain. Since a parenteral program could not easily be maintained for longer than two or three weeks, patients with severe protein deficiency obtained only a moderate nutritional benefit from this alimentation. Serum protein levels rose only slightly in some cases, in others not at all. Nevertheless, the parenteral feeding was frequently associated with a sense of well being, part of which may have been due to restoration of normal water and electrolyte patterns, both extracellularly and in the cells themselves. The protocols of two cases are shown in Figures 2 and 3.

The clinical impression gained by these studies was that the parenteral injection of amino acids was an important nutritional instrument in the pre- and postoperative management of patients with surgical diseases, but that it was impractical, when used as the only source of nitrogen, in restoring the large nitrogen losses of such patients. On the other hand, it was recognized that if such a parenteral regimen were supplemented by large transfusions of blood, and by as high an oral nitrogen intake as possible, much better and faster clinical improvement could be achieved.

SUMMARY

Protein deficiency is an important cause of clinical debility in a variety of diseases, particularly in surgical gastro-intestinal diseases. It can usually be recognized by a determination of the serum protein concentration, if proper precautions are taken and especially if consideration is given to the plasma volume.

A high protein diet should be prescribed

both as prophylaxis and as treatment for patients who are to undergo extensive gastro-intestinal operations. Whole blood transfusions before and after operations are valuable in combatting anemia and in anticipating protein losses. Plasma transfusions are important in acute serum protein losses, but are impractical as a method of restoring long standing protein deficiency.

Special concentrated proteins should be used to augment the protein content of the diet. It is possible by such means to give 300 Gm. or more of protein a day for long periods. For patients unable to take any or adequate quantities of protein by mouth, the parenteral injection of amino acids becomes the only practical means of producing positive nitrogen balance. However, careful balance studies demonstrate that such a parenteral program, which must include injections of salt, glucose and vitamins, usually produces a retention of no more than about 4 Gm. of nitrogen daily. Since many surgical patients may have a deficiency of 450 or more Gm. of protein, such a parenteral program is inadequate and must be supplemented by whole blood transfusions and by resort to high protein feeding as soon as the patient is able to take food by mouth.

Blood chemical changes following amino acid injection are usually insignificant. Only when the speed of injection is higher than 25 Gm. per hour, does the plasma amino acid level rise high enough to produce nausea, vomiting and other symptoms.

SOMMAIRE

La déficience des proteines est un facteur important de la faiblesse, de la débilité cliniques d'un grand nombre de maladies, surtout des maladies gastro-intestinales du domaine chirurgical. Généralement on reconnaît cet état par la détermination de la concentration du serum protëine en prenant les precautions requises et en prenant aussi en considération le volume du plasma. Une diète renfermant une haute quantité prophylactique et comme traitement chez tous les malades qui doivent être opérés pour des lésions gastro-intestinales importantes. Des transfusions sanguines seront employées avant et après, l'acte opératoire pour combattre l'anémie et atténuer les pertes de serum proteine. Les transfusions de plasma sont utiles pour remédier aux pertes aiguës de proteine mais ne sont pas d'un usage pratique pour remédier aux déficiences de longue durée.

Des préparations de proteines concentrées seront employés pour augmenter les proteines de la diète. Il est possible de donner 300 grammes ou plus par jour de proteine pour de longues périodes. Pour les malades qui ne peuvent pas prendre une quantité adéquate de proteine par bouche, on aura recours aux injections parentérales. Il faut dans ces cas inclure du sel, du glucose et des vitamines. Comme de nombreux malades ont une déficience de 450 grammes ou plus de proteines, les injections parentérales seront supplémentées par des transfusions sanguines et aussi une haute quantité de proteines par bouche aussistat que le malade peut être alimenté par la voie buccale. Les changements chimiques du sang par suite de l'emploi parentérale de proteines sont insignificants. Seulement quand la rapidité de l'injection dépasse 25 grammes par heure il y a parfois des nausées, des vomissements et d'autres symptômes.

SUMARIO

La deficiencia proteica es unt de las causas importantes de debilidad clínica en un gran número de enfermedades, y muy especialmente, en las enfermedades quirúrgicas del aparato digestivo. Esta deficiencia se puede diagnosticar determinando la concentración de las proteinas del suero en relación con el volumen total del plasma.

Una dieta rica en proteinas que son asimilables es de valor en el tratamiento profilactico y terapéutico de las enfermedades quirúrgicas del aparato digestivo.

Las transfusiones de sangre antes y despues de las intervenciones quirúrgicas son de gran valor en el tratamiento de la anemia y de la deficiencia proteica resultantes de la perdida de sangre durante dicha intervención.

Las transfuciones de plasma tienen gran valor terapéutico en el tratamiento de las perdidas agudas de las proteinas del suero,

pero son impracticas cuando esta perdida es crónica y de larga duración. En estos casos crónicos se debe de recurrir a las preparaciones especiales de proteinas concentradas en cantidad suficiente para suministrar una dieta que contenga por lo menos 300 gramos de proteinas diariamente; y cuando esto no es posible el tratamiento debe e ser complementado con las inyecciones parentericas de soluciones de aminoacidos, glucosa, cloruro de sodio y vitaminas. Si estas medidas no son suficientes para corregir la deficiencia entoces se debe de recurrir a las transfuciones de sangre periodicamente hasta que el paciente este en condiciones de ingerir una cantidad amplia y sufiente.

Las inyecciones parenterales de aminoacidos no producen cambios químicos de significancia en la sangre y solo causan reacciones caracterizadas por nausea, vomitos y otros síntomas toxicos, cuanda se inyecta mas de 25 gramos por hora.

Свод

Недостаток протеина является важной причиной клинического изнеможения при многих болезнях, особенно при желудочно-кишечных хирургических болезнях. Его можно распознать определением концентрации протеина сыворотки, но нужно принять правильные предосторожности и особенно принять во внимание объем плазмы.

Высокая протеиновая диэта для больных, которые должны подвергнуться большой желудочно-кишечной операции, является как профилактической, так и терапевтической мерой. Переливание полной крови до и после операции является очень ценной мерой для предупреждения анемии и потери протеина. Перелив плазмы очень важен при острой сыворочной потери протеина, но не практичен как способ восстановления протеинового недостатка, существовавшего долгое время.

Специальные концентраты протеина необходимы для повышения протеинового содержания диэты. Таким путем можно дать 300 граммов и больше протеина в день в течение длинного периода. Для больных, которые не могут поглотить адэкватное количество протеина, парэнтеральная инъекция аминокислот является единственным практическим способом обеспечения положительного азотного баланса. Но точные исследования этого баланса показывают, что при такой парэнтеральной программе, включающей также инъэкцию салинов, глюкозы и витаминов, обыкновенно удерживается не больше чем 4 граммов азота ежедневно. Так как многие хирургические больные могут иметь недостаток 450 и более граммов протеина. то парэнтеральная программа не является адэкватной и должна быть пополнена переливом всей крови и высоким протеиновым питанием, как только больной может есть.

Химические кровяные переливы после вливания аминокислот незначительны. Только когда быстрота вливания превосходит 25 gm. в час, уровень аминокислот в плазме повышается достаточно, чтобы произвести тошноту, рвоту и другие симптомы.

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Rupture of the Cervical Intervertebral Disks*

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PAIN in the arm and shoulder is a complaint almost as common as backache and sciatica. These symptoms are too frequently called neuritis—toxic or inflammatory in origin. With a better understanding of the mechanical factors involved in weight bearing, these misconceptions with respect to the painful arm and shoulder and the painful back and leg are gradually becoming obsolete.

The purpose of this report is to discuss one of the more common causes of shoulder and arm pain and at the same time to indicate the pathologic conditions which must be considered in the differential diagnosis.

LITERATURE

Early reports of cervical intervertebral disk ruptures indicate that the lesion is most likely to be confused with neoplasms of the spinal cord. These observations were limited to cases in which the rupture occurred near the midline where direct pressure upon the cervical spinal cord resulted. Such lesions do produce symptoms not unlike those of neoplasms of the cervical spinal cord, and in many instances it is impossible to distinguish them preoperatively.

It was not until Semmes and Murphy[15] described the relatively minor symptoms produced by lateral rupture of the cervical intervertebral disk, that an appreciation of this type of lesion received wider recognition. Since the publication of this important article, numerous observers[8, 18] have described in minute detail the diagnostic features of lateral rupture of the fifth, sixth and seventh cervical intervertebral disks.

Other observers[2, 8, 18] have described symptoms produced by bony spurs protruding into the intervertebral foramina, thereby compressing the cervical nerve roots. Nachlas[11] quite rightly indicated that most cases of scalenus anticus syndrome were really cases of cervical root compression at the intervertebral foramina. He obtained relief in many of them by traction of the cervical spine. Oppenheimer and associates,[13, 14] after the study of 50 similar cases, came to the same conclusion. Keyes and Compere[9] called attention to these hypertrophic bony changes, but indicated that the lesion was probably initiated by a damaged intervertebral disk at the site of the bony spur and that primary cervical arthritis rarely caused localized root compression.

The role of the scalenus anticus muscle in the production of arm and shoulder pain has been stressed by numerous authors.[7, 15, 16] While its importance has undoubtedly been overemphasized, this syndrome still remains an important one in the differential diagnosis.

ANATOMY AND PHYSIOLOGY

The cervical spinal canal is more nearly filled with nervous tissue than either the dorsal or lumbar regions; consequently, any intraspinal mass causes early symptoms of cervical cord deficit. This is particularly true with ruptured intervertebral disks in which the mass of herniated nuclear material projects into the spinal canal near the midline. Such a lesion is of serious consequence because the direction of thrust backward into the spinal canal is in the immediate vicinity of the anterior spinal artery, and once this vessel is compressed, irreparable damage to the spinal cord rapidly ensues.

The cervical spinal roots, unlike the dorsal and lumbar roots, emerge from the dura mater at right angles and lie immediately over the intervertebral disks. As a consequence, a lateral protrusion of the cervical disk may compress the nerve roots against the ligamentum flavum, lamina, pedicle or facet without much damage to the spinal cord (Fig. 1).

The intervertebral foramina of the cervical spine have long vertical diameters with shal-

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low anteroposterior diameters. The roots, as they pass through these foramina, are especially vulnerable to pressure from a small bony spur or a laterally placed herniation of the nucleus pulposus (Fig. 2).

The points of greatest strain in the cervical spine are at the fifth and sixth interspaces. Roentgenologists have long recognized the frequency with which the intervertebral disk is narrowed at these levels. The narrowed disk may be associated with x-ray evidence of localized arthritis (Fig. 3). Many patients with such x-ray findings have no symptoms referable to the neck or arms.

The cervical spinal cord is composed of eight segments with eight anterior roots and seven posterior roots; the first cervical posterior root is usually absent. The first cervical motor root leaves the canal between the occiput and the atlas. The eighth cervical nerve exits at the foramen between the seventh cervical and first thoracic vertebrae. Therefore, a disk lesion at C-5 (between the fifth and sixth cervical vertebrae) causes direct impingement upon the sixth cervical nerve root, and one at C-6 (between the sixth and seventh cervical vertebrae) compresses the seventh cervical root. Recognition of this anatomic arrangement is important if the lesions are to be localized accurately on clinical findings.

PATHOLOGY

Cervical ruptured disks may follow severe or minor injuries to the neck; many patients, however, give no history of trauma. In analyzing the reported cases, it would appear that the midline cervical disk lesions which compress the spinal cord are much more frequently the result of trauma than the small laterally placed lesions which cause only arm and shoulder pain. That degenerative processes play an important role in the production of the lesion is indicated by the frequency with which there is roentgen evidence of localized arthritic spurs and narrowing of the intervertebral disk at the site of the lesion.

The quantity of nucleus pulposus in a herniated cervical disk is relatively small as compared with that in the lumbar region. As a consequence, even in acute cases, one is surprised to find at operation a relatively small mass compressing the nerve root or even the spinal cord. In many instances, the herniated portion of the disk is surrounded by bone. These bony prominences, known as osteophytes, may project into the intervertebral foramina.

SYMPTOMS

Pain and stiffness of the neck are usually the first symptoms. Not infrequently, after the initial bout of stiff neck, the patient will

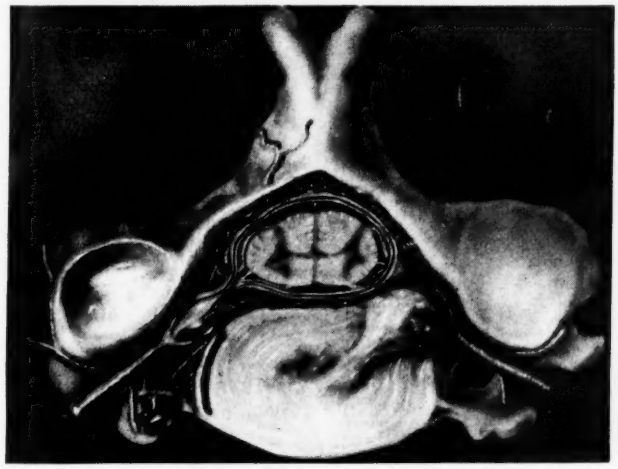

Fig. 1.—Diagram showing mechanism by which laterally placed, ruptured disk may compress nerve root without appreciable impingement on spinal cord.

experience no further local discomfort. Symptoms may consist entirely of pain into the shoulder and down the arm into the hand. Any sudden movement of the head or neck, coughing, straining or sneezing may intensify the pain or produce a feeling of "electric shock" into the arm and hand.

The pain is usually made worse by maintaining a single position. Not infrequently, a patient will get out of bed several times at night to change his position completely in order to relieve the discomfort. The points of maximum pain are the base of the neck, the tip of the shoulder and the arm down to the elbow. Occasionally, the pain extends into the hand, but paresthesias and numbness in the hand are usually more aggravating than is the pain.

Not infrequently, the patient states that his whole hand "goes to sleep," that it has a feeling of numbness, that it feels cold to touch and that it appears blue in color. As will be pointed out later, these vascular symptoms are part of an associated scalenus anticus muscle spasm which may completely becloud the clinical picture. Weakness of the arm and at times atrophy and fibrillation of muscles are frequently noted and may be severe.

If the lesion is a large one and compresses the cervical cord, the usual symptoms of spinal cord deficit are present. These symptoms are identical with cervical cord tumor and will not be reiterated here.

SIGNS

Sensory.—Strangely, many patients complain severely of recurrent numbness and tingling into the hand and forearm, and yet no sensory deficit can be demonstrated by the usual clinical tests. In the same case, if the neck and head are tilted toward the painful side and pressure is applied to the top of the head, the whole radicular pattern may be reproduced. If the compression has become long and severe, sensory deficit can usually be demonstrated with ordinary tests. Paresthesias can occasionally be demonstrated by gently stroking the skin in the involved dermatome. The sensory patterns associated with lesions of the sixth and seventh cervical roots are illustrated in Figures 4 and 5.

Motor.—Objective muscular weakness may be difficult to demonstrate, even though the patient complains that the involved extremity is weaker than normal. When muscle deficit can be demonstrated, it may have great diagnostic as well as localizing significance. The biceps brachialis is supplied chiefly through the fifth and sixth cervical nerve roots; whereas the triceps brachialis is supplied chiefly through the seventh and eighth cervical nerve roots. Therefore, weakness of the biceps with normal triceps function frequently occurs with lesions of the sixth cervical root (the disk between the fifth and sixth cervical vertebrae). A weak triceps and a normal biceps indicate a lesion of the seventh cervical nerve root (the disk between the sixth and seventh cervical vertebrae).

Reflex Changes.—Lesions at C-5 disk are characteristically associated with diminution or absence of the biceps reflex; whereas lesions at C-6 disk are associated with diminution or absence of the triceps jerk. The other tendon reflexes in the upper extremity are usually not involved with lesions at these levels.

Spinal tenderness at the site of the lesion is a frequent finding as in lumbar herniations of the nucleus pulposus. Percussion or pressure to the painful side of the midline may reproduce the radicular pain or paresthesias —radiating percussion pain (Fig. 6).

The most important diagnostic test and one that is almost pathognomonic of a cervical intraspinal lesion is the *neck compression test* (Fig. 7). Tilting the head and neck toward the painful side may be sufficient to reproduce the characteristic pain and radicular features of the lesion. Pressure on the top of the head in this position may greatly intensify the symptoms. Tilting the head away from the lesion usually gives relief.

DIFFERENTIAL DIAGNOSIS

Bony lesions of the cervical spine, either neoplastic or inflammatory, may compress one or more nerve roots in the foramina and cause radicular pain similar in every respect to cervical disk lesions. Neoplasms of the spinal cord, particularly those arising from

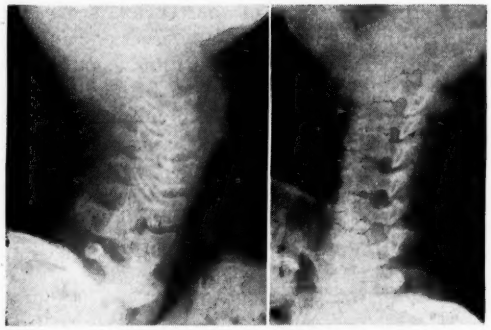

Fig. 2 *(left)*.—Oblique view of cervical spine showing narrowing of intervertebral foramen at C-5. Note small osteophytes on anterior margin of foramen. Fig. 3 *(right)*.—Lateral view of cervical spine. Arrow points to narrowed disk between fifth and sixth cervical vertebras. Note chip fracture of superior surface of body of fifth cervical.

Fig. 7.—Method of performing neck compression test in patients with suspected ruptured cervical disks.

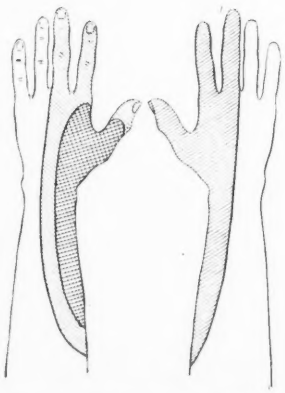

Fig. 4 *(left)*.—Dorsal view of forearm and hand showing approximate areas into which pain or paresthesias radiate or in which sensation is diminished, when sixth and seventh cervical roots are compressed. Cross-hatched area corresponds roughly to sixth cervical dermatome, lined area to seventh cervical dermatome. Fig. 5 *(right)*.—Ventral view of forearm and hand showing approximate area into which pain or paresthesias radiate or in which sensation is diminished, when seventh cervical root is compressed.

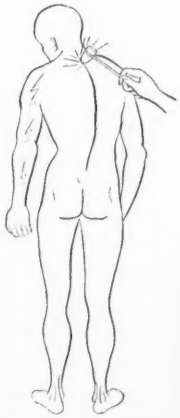

Fig. 6. — Radiation pain can frequently be produced by percussing directly over lesion. When positive, test causes pain or paresthesias to radiate into shoulder and arm.

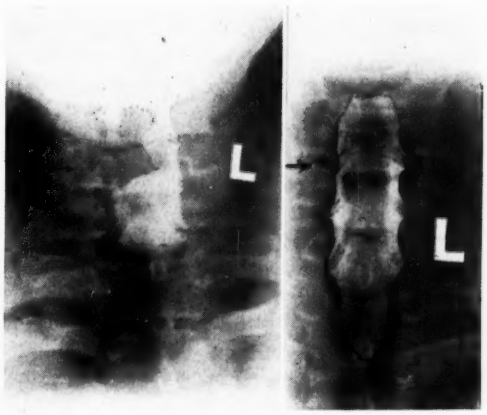

Fig. 8 *(left)*.—Pantopaque myelogram. Arrow points to large filling defect in opaque column. Ordinarily, laterally placed, ruptured disk does not produce such large deformity. Fig. 9 *(right)*.—Pantopaque myelogram. Arrow points to obliterated axillary pouch at C-5. This deformity is characteristic of laterally placed, ruptured disk pushing into intervertebral foramen.

the nerve roots, may give identical symptoms.

Scalenus anticus compression, with or without cervical rib, is the lesion most easily confused with ruptured cervical disks. The most important differential feature is that the nerve pain and paresthesias from scalenus anticus compression are referred to the dermatomes of the *first thoracic and eighth cervical* nerve roots (the ulnar distribution); whereas the pain and paresthesias of cervical disk lesions are in the distribution of the sixth or seventh cervical nerves (radial or median distribution). Cervical ruptured disks below the level of the sixth interspace rarely occur; therefore, it should not be too difficult to separate the two lesions in the differential diagnosis. Furthermore, the scalenus anticus syndrome characteristically has a vascular component since the subclavian artery is so easily compressed against the first rib in the scalenus angle.

It should not be forgotten that any lesion of the cervical spine may produce spasm of the scalenus muscle. It is not uncommon, in fact, to have the clinical features of a ruptured cervical disk overshadowed by a superimposed scalenus syndrome. However, if by compressing the neck toward the painful side, pain, paresthesias and numbness into either the sixth or seventh cervical dermatome are produced, one may be sure that the symptoms are not due to scalenus compression, for these nerves cannot be involved by pressure within the scalenus angle.

Undoubtedly the most common lesion producing pain in the shoulder and arm is fibrous ankylosis of the shoulder joint. The pathologic anatomy of this lesion has not been completely clarified, inasmuch as it is still described by various authors as fasciitis, bursitis, myositis, arthritis and fibrous ankylosis of the shoulder. In all such lesions some degree of spasm of the scalenus anticus muscle is evident; in some cases a compression of the neurovascular elements within the scalenus angle is sufficiently severe to cause deficits in both the vascular supply and the nerve function. Recognition of these lesions should not be particularly difficult, inasmuch as there is always present some degree of limitation of movement of the shoulder, particularly backward rotation and abduction.

ROENTGEN EXAMINATION

Plain x-ray films of the cervical spine give invaluable evidence in many cases of ruptured cervical disks. The lateral films usually show narrowing of the interspace with loss of the normal lordotic curve even in a hyperextended position. Oblique views may show narrowing of the intervertebral foramen with proliferation of bone in the foramen (osteophytes). These proliferative bony changes may be bilateral even though the symptoms are unilateral.

Pantopaque myelography is an exceedingly accurate method of diagnosing ruptured cervical disks. In the prone position, 6 cc. of pantopaque are injected into the subarachnoid space by lumbar puncture. Before tilting the table, the patient's head is held fully extended by placing a small pillow under the chin, in order that the contrast material does not run into the basal cisternae of the skull. The head of the table is then tilted downward just enough to permit the pantopaque to collect in the cervical gutter. A series of anteroposterior films are then made after balancing the column at the desired level with the fluoroscope. The anterior surface of the cervical canal is outlined clearly, and each nerve root with its axillary pouch may be accurately identified. Larger lesions show a defect in the column (Fig. 8). Smaller lesions may show no defect other than an obliteration of an axillary pouch and root sleeve (Fig. 9).

TREATMENT

Conservative.—Conservative measures, undoubtedly, have an important place in the treatment of ruptured cervical intervertebral disks, particularly if the symptoms are purely radicular with no evidence of cord compression. If the lesion is suspected of being a fairly large one (as indicated by muscular wasting or marked sensory loss in the arm with or without signs of spinal cord deficit), then prompt operative intervention is advisable because of the dangers of irreparable damage to the cervical cord.

For the milder cases, a period of bedrest with halter traction may give lasting relief. The patient should have absolute bedrest and from 5–10 lb. traction applied continuously.

If after three or four days there is no relief of radicular pain and muscle spasm, further conservative treatment will probably be of little avail. If the patient is comfortable in traction and the pain recurs mildly when weight bearing is resumed, a well fitting cervical collar support may give symptomatic relief.

Manipulation of the cervical spine in the presence of a ruptured intervertebral disk is a dangerous procedure and may result in irreparable damage to the spinal cord.

Operative Technic.—The upright position is ideal for operations in the lower cervical region (Figs. 10 and 11). Procaine nerve block or endotracheal ether anesthesia is equally satisfactory.

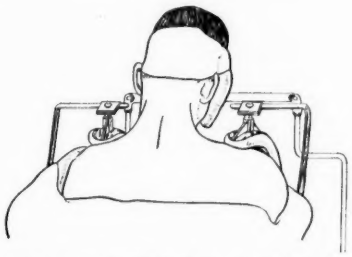

Fig. 10.—Posterior view of patient in upright position for lower cervical hemilaminectomy. Note line of operative incision.

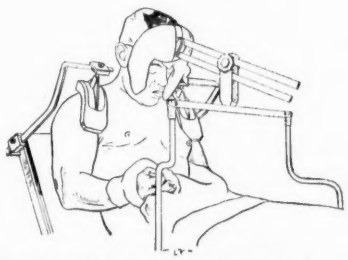

Fig. 11.—Oblique view of patient in upright position, using head rest devised by W. McK. Craig, Mayo Clinic.

A straight incision is made from the spinous process of the vertebra above to the one below the level of the lesion. The muscles are freed from the spinous process on the side of pain, and, after denuding the laminae of soft tissue, a triangular piece of bone is removed from the laminae above and below the lesion with a small dental chisel. This exposes the ligamentum flavum, which in the lower cervical region is almost completely covered with bone. The inner edge of the articular facet is then chiseled away, thus providing good exposure of the root and the lateral edge of the dura mater covering the cord (Fig. 12). If the bony incision is placed correctly, even the predural fat need not be disturbed. The spinal root will be found to be wedged tightly into the intervertebral foramen by the anterior mass. With careful dissection, the root is separated from the mass and retracted either upward or downward, so that the mass may be removed with as little trauma to the root as possible. In case of the "soft" disk, bits of typical herniated nucleus pulposus may be lifted out of the tear in the annulus fibrosus. If the lesion is an old one and has become surrounded by a bony spur, it may be necessary to chisel away the spur and remove the base of it with a curette. Then the posterior rim of the intervertebral foramen is removed completely with a nasal punch, so that complete decompression of the involved nerve root is provided.

After all bleeding is carefully controlled, the usual anatomic closure of the wound is carried out by interrupted sutures of black silk.

Postoperative treatment.—The patient is kept in the recumbent position just so long as there is residual pain in the arm and shoulders. Some patients are comfortable immediately, while others have rather severe radicular pains for several days. A number of our patients have been out of bed on the first postoperative day; others have not been able to bear weight without pain for 10–12 days. With the operation performed in this manner, there is very little damage to the weight-bearing structures of the neck and, therefore, early ambulation is not considered harmful.

RESULTS

Relief of radicular pain within two weeks following operation is to be expected. In our own series of 32 cases, severe radicular pain has invariably disappeared.

The neck remained stiff for varying periods of time—sometimes as long as six or eight weeks postoperatively—but in other cases it disappeared almost immediately.

Vague paresthesias and hypesthesias are apt to persist for weeks or months postoperatively. When two nerve roots must be exposed at the operation, either because of a disk at two levels or because the operative approach was misdirected at the wrong interspace, the paresthesias and hypesthesias are much more severe and lasting than if only one nerve root requires manipulation.

The neurologic deficits usually clear up within a period of four to five months, and the reflex activity of the muscle groups involved is usually normal after six months.

Recurrences are rare. In only one instance of our series has there been a verified recurrence, and that was on the opposite side at the same interspace.

ADDITIONAL DATA

The true or relative incidence of ruptured cervical disks cannot now be stated because of insufficient data. Our experiences with both cervical and lumbar ruptured disks indicate that the relative frequency of the two lesions is 1:12. I have no doubt that when the clinical features of ruptured disks in the cervical region are as well understood as are those in the lumbar region, this ratio will probably be reduced.

Ruptured disks in the cervical region characteristically occur in patients over 40 years of age; there has been but one patient in our series under 30 years of age. This finding is in contrast to the ruptured lumbar disks, where age seems to be no factor.

Trauma as a predisposing factor for cervical disk lesions is of relatively minor importance. Certainly, not more than one third of our patients have given an unequivocal history of injury to the neck.

Twice as many ruptured cervical disks occur at the sixth interspace as at the fifth interspace. In about 10 per cent of the cases, a disk at both levels may be found in the same patient. The diagnosis of a double disk may be made by clinical findings, but verification with pantopaque myelography is usually advisable.

SUMMARY

1. Lateral rupture of the lower cervical intervertebral disks is a common cause of

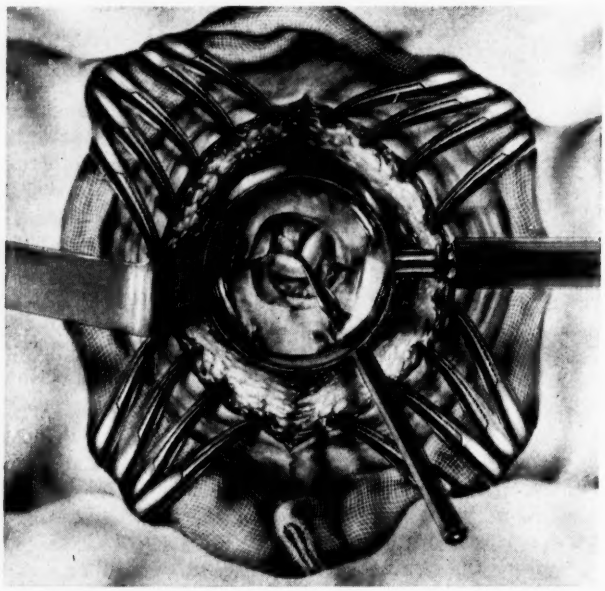

Fig. 12.—Operative field showing exposure of sixth cervical root with minimal removal of bone. Note herniated nucleus pulposus presenting beneath retracted nerve root.

radicular pain affecting the upper extremity.

2. The clinical syndrome is remarkably constant and easily recognized.

3. Accurate localization of the lesion on clinical findings is usually possible. The salient features are as follows.

The Fifth Cervical Disk.—(a) Pain radiating from the neck into the shoulder and arm with paresthesias (needles and pins or numbness) into the posterior aspect of the thumb. Symptoms always aggravated by tilting the head to the painful side. (b) Weakness or absence of the tendon reflex of the biceps brachialis muscle.

The Sixth Cervical Disk.—(a) Pain radiating from the neck into the shoulder and arm with paresthesias (needles and pins or numbness) into the index, middle and perhaps the ring fingers and tip of the thumb. Symptoms aggravated by tilting head to the painful side. (b) Weakness or absence of the tendon reflex of the triceps brachialis muscle.

4. The lesion can in most instances be accurately verified by pantopaque myelography.

5. Conservative treatment relieves symptoms in many cases. When conservative measures fail, operative removal of the lesion is justified on the basis that it is a simple, safe procedure and the results are excellent.

SOMMAIRE

1. La rupture latérale des disques intervertébraux cervicaux est une cause fréquente de douleurs radiculaires du membre supérieur.

2. Le syndrome clinique est constant et facilement reconnu.

3. Une localisation précise de la lésion est ordinairement possible. Les signes saillants sont les suivants:

Cinquièsme disque cervical: a. Douleur sétendant du cou à l'épaule et au bras avec paresthésies (fourmillements et engourdissements) de l'aspect postérieus du pouce. Il y a toujours augmentation des symptômes quand le malade penche la tête vers côté douloureux. b. Affaiblissement ou absence du réflexe tendineux du biceps du bras.

Sixième disque cervical: a. Douleurs rayonnants au cou et à l'épaule avec paresthesies (fourmillements et engourdissements) de l'index, du majeur de l'annulaire et de la pointe du pouce. Aggravation des symptômes quand le inglade penche la tête vers le côté douloureux. b. Affaiblissement ou absence du reflexe tendineux du biceps du bras.

4. Généralement, les lésions peuvent être vérifiées par la myélographie pantopaque.

5. Dans lu majorité des cas le traitement conservateur suffit. Le traitement opérative, l'ablation de la lésion est justifiable, vu qu'il est facité, n'offre presque pas de danger et que les résultats sont excellents.

SUMARIO

La rotura de la porción lateral de los discos intervertebrales de la región cervical inferior es muy frecuentemente la causa de dolores radiculares de los miembros superiores. Dicha rotura produce un síndromo que generalmente es muy caracteristico y por lo tanto facil de reconocer.

La rotura del quinto disco cervical produce dolores rediculares que radian de la región del cuello hacia el hombro y al brazo del mismo lado y son acompanados de parestesias que se extienden hasta la región posterior del dedo gordo. Este síndromo se agrava cuando la cabeza se inclina hacia el lado doloroso. El examen neurologico en estos casos generalmente presenta la ausencia del reflejo bicipital.

La rotura del sexto disco cervical tambien produce dolores que se extienden al hombro y al brazo del mismo lado pero las parestesias que lo acompanan afectan los dedos segundo tercero y cuarto con disminución o ausencia del reflejo tendinoso del triceps braquial.

La mielografia panto opaca generalmente verifica el diagnóstico de dichas lesiones. El tratamiento conservativo da resultados en un nùmero de casos pero cuando esta falla se debe de recurrir al tratamiento quirùrgico.

SOMMARIO

1. Rottura laterale del disco cervicale intervertebrale basso e un caso comune di dolore radicolare commuovente la estremita superiore.

2. Il sindrome clinico e rimarchevole, costante e facile riconosciuto.

3. Accurata localizzione della lesione nelle trovate cliniche e usualmente possible. La fattezze del saliente sono come segue:

Il Quinto Disco Cervicale. (a) Dolore

(Continued on page 512)

The Training of the Neurosurgeon

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IN the last generation it was customary for the professor of surgery to operate on all parts of the body. Of this universal virtuosity Professor Jirasek has been an excellent example. Recently, however, because of the increasing complexity of our knowledge and technical appliances, the tendency has been for surgeons to specialize in the surgery of some system of organs, such as the thoracic organs, abdominal organs, organs of locomotion, etc. Doubtless, with the reorganization of the Czech medical schools after the war, this problem will be discussed.

One of the most recent of these specializations has been surgery of the nervous system. A great deal of attention has been given lately to the training of the neurologist, but neurosurgeons, like Topsy, have just "growed." The requirements for certification by the American Board of Neurological Surgery may be taken as the least common denominator, but not as an ideal scheme, for such training. They are as follows:

1. Graduation from a medical school of the United States or Canada recognized by the Council on Medical Education and Hospitals of the American Medical Association, or graduation from a foreign school which is acceptable to the American Board of Neurological Surgery, Inc.

2. Completion of a surgical internship of not less than one year in a hospital approved by the same council, or its equivalent in the opinion of the Board.

3. A period of graduate study in a recognized school of medicine of not less than three years beyond the intern year, or in an approved hospital or under a sponsorship acceptable to the American Board of Neurological Surgery, Inc., for the training of neurological surgeons.

This period of special training shall be of such a character that the relation of the basic sciences of anatomy, physiology, pathology, bacteriology and biochemistry is emphasized. Knowledge of these sciences as applied to practice of neurological surgery will be required in the examination.

An additional period of not less than two years in the practice of neurological surgery.

The main defect of this scheme is the inadequate training required in neurology, both basic and clinical. This is serious, because the neurosurgeon cherishes his independence and has been accepting more and more neurological work for which he has been inadequately prepared. The result has been that the neurologist finds himself squeezed between the surgeon who takes the organic cases and the psychiatrist who takes the functional ones. When it is remembered that the internist also takes over any diseases for which an effective medical treatment is discovered, and that the pediatrician takes everything below a certain age limit, it is evident that the neurologist is liable to be limited to a few degenerative disorders of dubious prognosis.

This would be all very well but for two considerations. In the first place, all of these other specialists are inadequate neurologists. Neurology is a complicated body of knowledge sufficiently extensive to tax the ability of any one man to master well enough to diagnose difficult cases and to teach the subject to others. Such diagnosticians are necessary, and ways must be found for them to earn a livelihood. At present it is increasingly difficult to find intelligent young physicians who are willing to enter the field. In the second place, since specialization is necessary because of the increasing complication of medicine and the length and expense of medical training, it is the duty of physicians to seek such a division of labor as is most advantageous to their patients. From this viewpoint one cannot regret that organic neurological maladies are taken from the hands of the psychiatrist, who has become less and less interested in them, but one may doubt whether the patient will profit by passing into the hands of the surgeon, unless the latter has a better training in the field than is at present required by the American Board.

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One well known neurosurgeon remarked to me, "What need have we of neurologists? Have we not air and lipiodol?" He might have also added thorotrast. He was right from his viewpoint, because the neurosurgeon is usually interested only in determining whether there is a surgical lesion present, and this question he has found means of answering often without the necessity of much knowledge or thought. But communities which have only a neurosurgeon of this type must have also a neurologist to answer the innumerable other questions which arise and to care for non-surgical neurological disorders.

The difficulty arises partly because neurosurgery is a recent specialty and its practitioners have entered the field in various ways. Successful neurosurgery began about 1903 with Cushing and Frazier. Both of these men were general surgeons and both were professors of general surgery in medical schools, although both became increasingly incompetent general surgeons as the years went by and increasingly more competent neurologists. Cushing long maintained that neurological surgery must be approached through general surgery, although his confidence in its necessity was shaken by the success of Clovis Vincent. He was not impressed by Foerster, because Foerster, like Horsley, was primarily a physiologist. But he had to admit that Vincent, with no training in general surgery, had become a first rate neurological surgeon. It is admitted that anyone who would operate on the nervous system must learn the principles of surgery—shock, hemorrhage, asepsis, etc.,—but a long apprenticeship in general surgery has been shown to be unnecessary.

There remains the matter of temperament, largely inborn. The most successful surgeons are motor types, not much given to reflection. Perhaps what I have in mind can be understood by comparing Jackson and Horsley or, in this country, Cushing and Mitchell. Not that Cushing and Horsley did not think, but they usually solved their problems by manipulation. When Cushing planned an address, for example, he did not sit down and think about it, he seized a pen and began to scribble.

It has long been my practice, when taking young men for training in the field of nervous diseases, to give them a fundamental basic training, meanwhile observing their interests and aptitudes. The scheme is as follows:

FIRST YEAR:

Morning: Advanced study and research in the anatomy of the nervous system. The student is taught the Golgi, Cajal, Marchi, Nissl and Weigert methods and learns with what immense labor our knowledge of the nervous system has been acquired.

Afternoon: Polyclinic. Here he learns to make a systemic neurological examination and gets acquainted with the usual ambulatory neurological cases.

SECOND YEAR:

Morning: Resident for medical neurological cases in the hospital. He becomes now acquainted with the more serious neurological disorders. All of the patients admitted to the hospital pass through his hands.

Afternoon: Neuropathology. He is responsible for all the pathologic material, both surgical and autopsy. He learns modern neuropathologic technic, both German and Spanish, and sees daily the lesions which are responsible for the symptoms he observes in the wards.

THIRD YEAR:

Morning: Resident for surgical neurological cases. He assists in all operations on the nervous system.

Afternoon: He assists in advanced study and investigation of the reflex and electrophysiology of the nervous system.

At the end of this period, the apprentice who obviously delights in manual manipulation is advised to continue in the field of neurosurgery; the one who delights in the intellectual intricacies of the nervous system is directed toward clinical neurology. It has happened also that apprentices have shown an aptitude and interest in the mental aspects of the disorders which came under their care, and they have been directed into psychiatry. All have profited by their basic training. The neurosurgeon has some appreciation of the intricacies of the nervous system which keeps his thumbs out of important parts of the

brain; the neurologist can better judge the fantastic claims of some neurosurgeons; and the psychiatrist has a better appreciation of the importance of the brain for the normal functioning which we call sanity.

Finally, in the present fallible state of mankind, and its imperfect organization into societies, perfection can only be approached, never reached. It is the duty of every clinic to seek the organization which is most effective with the personnel and means at its disposal.

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RUPTURE OF THE CERVICAL INTERVERTEBRAL DISKS

(Continued from page 509)

sviluppatosi dal colo dentro le spalle e braccio con parestesia (aghi spille oppure destituto) dentro l' aspetto posteriore del pollice. Sintomi sempre agravati nell' alzare la testa nel fianco del dolore. (b) Debolezza ad assensa del riflesso tendine alle muscole del bicipide brachiale.

Il Sesto Disco Cervicale. (a) Dolore sviluppatosi dal collo dentro le spalle e braccio con parestesia (aghi e spille oppure destituto) dentro l' indice medio e puranco il dito dell anello e la punta del pollice sintomi aggravati nell alzare la testa nel fianco del dolore. (b) Debolezza od assensa de diflesso tendine del tricipide muscole brachiali.

4. La lesione puo in tante istanse essere accuratamente verificata da mialografia pantopaque.

5. Conservativo trattamento sollieva i sintomi in tanti case. Quando misure conservative falliscono rimozione operativa della lesione e guistificata nella base che e una semplice sicura procedura ed i risultati sono eccellenti.

Свод

1. Латеральная грыжа нижних шейных межпозвоночных дисков является частой причиной радикулярной боли верхней конечности.

2. Так как клинический синдром очень постоянный, то его легко распознать.

3. Обычно возможна аккуратная локализация на основании следующих характерных данных:

Пятый шейный диск: (а) Боль распространяется от шеи в плечо и предплечье, с парестезией (уколы и онемение) в тыловую поверхность большого пальца. Симптомы ухудшаются наклонением головы в болезненную сторону; (б) Констатируется слабость или отсутствие сухожильного рефлекса biceps'a brachialis.

Шестой шейный диск: (а) Боль распространяется от шеи в плечо и предплечье, с парестезией (уколы и онемение) во второй, третий, четвертый и кончик большого пальца. Симптомы ухудшаются наклонением головы в болезненную сторону; (б) Констатируется слабость или отсутствие сухожильного рефлекса biceps'a brachialis.

4. Диагноз обычно может быть подтвержден рентгенонепроницаемой миэлографией.

5. Консервативное лечение дает симптоматическое облегчение. Но когда оно не успешно, то вполне оправдывается хирургическое удаление диска, так как операция является простой и безопасной и дает отличные результаты.

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Liver Function in Surgery

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THE extensive experiences with viral hepatitis during World War II also influenced the viewpoint of the surgeon toward the jaundiced patient. Whereas in previous years there was a tendency to consider the majority of jaundiced patients as surgical—i.e., suffering from obstruction of the extrabiliary ducts by stones, tumors or scars—this tendency has been reversed in recent years, so that now a jaundiced patient is considered primarily medical—i.e., suffering from hepatitis. Moreover, evaluation of liver function by various laboratory tests has progressed quite markedly, so that now the surgeon is more often than not confronted with results of laboratory tests indicating liver damage, a finding which is prone to confuse the picture rather than elucidate it, if the conditions leading to liver function impairment are not clearly manifested. In addition, the modern therapy of the patient with surgical jaundice includes dietary and other specific therapy which should be guided by knowledge of the degree of liver function impairment. This, too, forces the progressive surgeon to take the results of liver function tests into account. Finally, the introduction of liver biopsy has markedly improved the histologic interpretation of liver changes and thus permitted a better classification of the various pathologic phenomena associated with extrahepatic obstructive jaundice.

In view of these factors, it appears timely to analyze the liver functions as revealed by the various tests in a series of cases with proven surgical jaundice, and to try to explain the functional changes encountered by correlating them with pathologic alterations in the liver. Such an analysis may not only further the differential diagnosis of jaundice but may bring to the fore the importance of the status of the liver function in the decision of when to operate.

The material upon which this study is based is that of a large, general charity hospital. For this reason most of the cases were not seen in the early stages of jaundice, a time when they are usually observed in private practice. However, from the diagnostic viewpoint of the surgeon this factor may be of advantage, because the stage of the disease in which the patients are first seen in the charity hospital is about the stage in which, in general practice, surgical intervention is contemplated. This limitation screens out the milder, transient cases of obstructive jaundice in which, as a rule, surgical intervention is not considered.

MATERIAL AND METHOD

The material consists of 95 cases of jaundice, proven to be of surgical nature; the extrahepatic biliary obstruction was in 42 cases due to a malignant and in 53 cases due to a benign process. The following liver function tests were performed in all cases (the pathologic ranges as considered in this study are given in parenthesis): cephalin-cholesterol flocculation test [1] (above +); albumin globulin ratio (below 1.25); total cholesterol [2] (above 300 mg. per cent, a relatively high level which was chosen to include only cases with marked cholesterol elevation which probably would signify more likely extrahepatic biliary obstruction); cholesterol-cholesterol ester ratio (below 50 per cent); urinary urobilinogen excretion (reduction was considered if, using the quantitative method,[3] the 24 hour output was below 1 mg., or, using the rough

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Supported by a grant from the Jerome D. Solomon Memorial Research Foundation.

estimation in a 2 hour specimen,[4] the amount was below 1/2 unit; increase was considered above 3 mg. or above 3 units, respectively); serum alkaline phosphatase [5] (above 15 Bodansky units; above 4 units in adults is usually considered pathologic; however, cases of liver cell damage without extrahepatic biliary obstruction may quite often have values between 4–15 units; consequently the higher value was chosen so as to include most probably only cases of extrahepatic obstruction); serum nonprotein nitrogen (above 40 mg. per cent).

The following additional tests were done in most, but not in all cases: thymol turbidity [6, 7] test (above 4 units); oral hippuric acid excretion test [8] (less than 3 Gm.); plasma vitamin A[9] (less than 15 μg. in 100 cc.); fecal urobilinogen [3] (below 30 mg. in 100 Gm. stool).

Although in many instances these tests were repeated during the course of the observation period, in the following discussion only the initial list of liver function tests is considered. The results of the repeated tests and of additional tests such as urinary and serum bilirubin, prothrombin time, etc., were taken into consideration for the confirmation.

In addition to the function tests, the diagnosis was established by the findings at operation or autopsy. In some cases liver biopsies, performed either at operation or by needle aspirations,* and the subsequent clinical course confirmed the diagnosis. Cases in which it was not possible to arrive at a reasonably sure diagnosis were excluded.

Grouping of Liver Function Tests.—To evaluate the results of the liver function tests properly, the following grouping has been used.[10,11]

* For the performance of the latter we are obliged to Dr. D. D. Kozoll.

Indications of Liver Function Impairment	Indications of Marked Bile Flow Interference	Indications of Liver Function Impairment and/or Bile Flow Interference
Pathologic cephalin-cholesterol flocculation	Low fecal urobilinogen	Elevated serum bilirubin
Pathologic thymol turbidity	Low urinary urobilinogen	Bilirubinuria
Reduced albumin/globulin ratio	High total cholesterol	Bromsulfalein retention
Reduced plasma vitamin A	Markedly elevated alkaline phosphatase (above 15 units)	Reduced prothrombin time
Reduced hippuric acid excretion		Slightly increased serum alkaline phosphatase (up to 15 units)
Increased urinary urobilinogen		
Low cholesterol-cholesterol ester ratio		

On the basis of the first two columns, a division of jaundice cases into three groups can be made, namely, one showing only liver function impairment, a second one revealing only bile flow interference and a third one showing both. The third group of function tests indicating either liver cell damage or impairment of bile flow is not helpful in this differentiation and is therefore not considered here. This division is similar to that by Watson and Hoffbauer,[12] who divide liver function tests into those indicative of hepatic and those of cholangiolar dysfunction.

As stated, cases with liver function impairment are primarily considered medical, those with marked bile flow interference surgical. Since it is known that positive results in one or the other tests indicating liver function impairment may occasionally be found without any significant liver cell damage, only the finding of at least two such positive results was considered sufficient for the designation of liver function impairment in a case of jaundice. Based on these criteria the cases were grouped as seen in Table 1.

TABLE 1

Type of Obstruction	Cases with intact bile flow and impaired liver function	Cases with impaired bile flow but intact liver function	Cases with impaired bile flow and impaired liver function	Total
Benign	3	25	25	53
Malignant	0	11	31	42
Total	3	36	56	95

Analysis of Cases.—Table 1 shows that three cases revealed no pathologic results in the tests indicative of bile flow impairment, but

only evidence of impaired liver function. They were patients with incomplete biliary obstruction due to stones in whom, at the time of admission, the urinary urobilinogen level was normal or above normal; none of the other tests indicating biliary obstruction were positive. Follow-up determinations of urobilinogen excretion revealed fluctuating values; this observation, together with suggestive history and physical findings of rigidity and mass (enlarged gallbladder in one case) in the right upper quadrant, pointed to a surgical condition.

A far greater group, of which more than two thirds consisted of cases of benign obstruction, revealed impairment of bile flow, but no significant impairment of liver function. In nine of these cases no test indicative of impaired liver function was positive, whereas in the remaining 27 cases one of them was positive (Fig. 1). Of these, a pathologic albumin/globulin ratio was found 12 times; four times elevation of the nonprotein nitrogen was noted (this in cases with protracted jaundice), whereas the remainder was divided among the other function tests. In half of the cases of this group one of the tests indicative of bile flow impairment was positive; in the remainder two or more gave pathologic results.

The third group, the largest, revealed both impairment of liver function and of bile flow. There are more cases of malignant obstruction than of benign in this group, as seen in Table 1. In more than half of them more than two tests, indicative of liver cell damage, were positive, and in some up to five. Abnormal albumin/globulin and cholesterol-cholesterol ratios were found most often, followed in the order listed by abnormal thymol turbidity, hippuric acid, cephalin-cholesterol flocculation, nonprotein nitrogen, elevation of urinary urobilinogen and decrease of the plasma vitamin A level. A comparison of the tests indicative of impairment of bile flow in Figure 1 shows that in the second group two thirds of the cases have more than two tests positive, in contrast to the previously

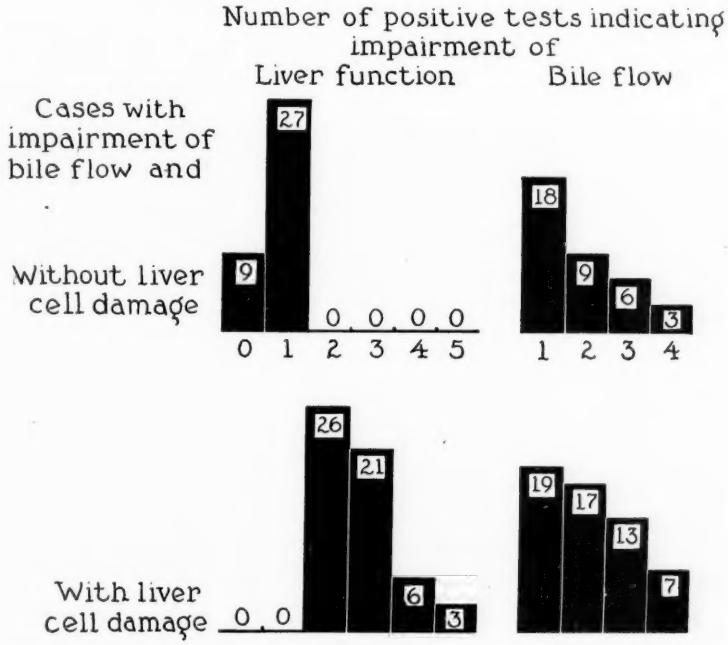

Fig. 1.—Distribution of number of positive liver function tests in cases with impaired bile flow with and without liver cell damage.

mentioned cases without liver function impairment. The abnormal tests indicating bile flow interference are basically not different in both groups. In general, however, the cases with liver function impairment have a higher number of abnormal tests than those without. A high serum alkaline phosphatase —i.e., above 15 Bodansky units—and absence of urobilinogen from the urine were the two most common signs of extrahepatic biliary obstruction, occurring in 70 and 59 instances, respectively, of the 95 cases. In 39 cases the total cholesterol was above 300 mg. per cent.

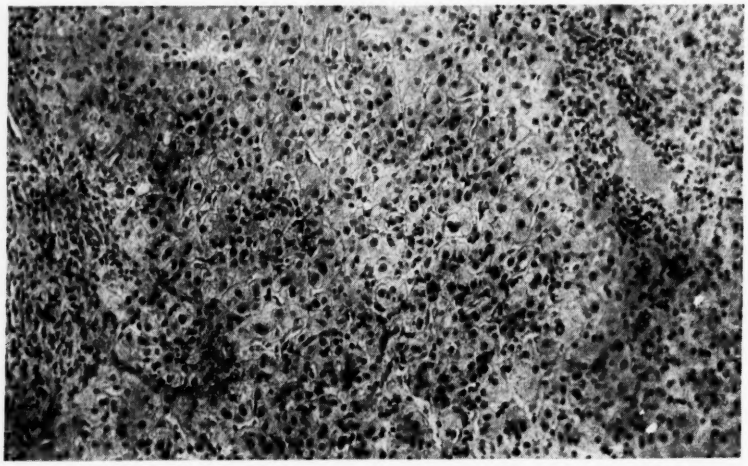

Fig. 2.—Biopsy specimen of patient with biliary hepatitis due to prolonged obstruction of common duct by carcinoma of pancreas. Marked bile stasis in center of lobules indicated by bile casts and intracellular pigment. Liver cells show irregular outline and variations in size. Slight cellular infiltraton in periportal fields.

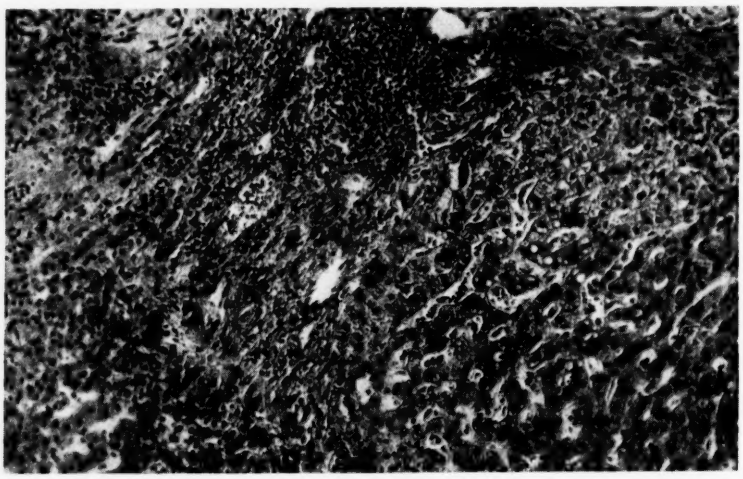

Fig. 3.—Biopsy specimen of patient with purulent hepatitis associated with impaction of stone in common duct. Liver cells reveal evidence of damage as indicated by variation in staining qualities and nuclear size. Kupffer cells are mobilized. Periportal fields show dense inflammatory infiltration, beginning fibrosis and some proliferation of bile ducts.

Causes of Liver Function Impairment.—Two pathologic processes can be considered responsible for the development of liver damage in cases of extrahepatic biliary obstruction. The first is the secondary liver cell damage produced by the retention of biliary substances—probably bile salts. This liver cell damage, which results in biliary hepatitis, is obviously dependent upon the degree and duration of the biliary obstruction. In our material of 44 cases of biliary hepatitis, 28 belong to the malignant and 16 to the benign group. The histologic changes in biliary hepatitis, as especially studied in liver biopsies, are fairly diagnostic (Fig. 2). In the center of the lobules many bile casts and dusty pigment in the liver and Kupffer cells can be seen. Occasionally necrobiosis of the hepatic parenchyma is noted. The periportal fields fail to show marked inflammatory changes. In a significant number of cases with biliary hepatitis more than two tests indicating bile flow impairment were positive. The serum alkaline phosphatase especially and the total cholesterol were almost always high. Of the tests indicating liver function impairment, only two were positive in most instances, especially the albumin/globulin and the cholesterol-cholesterol ester ratios. The cephalin-cholesterol flocculation, however, was negative except in two of the 44 cases. In this fact lies the most important advantage of this test. Actually, in combination with the histologic picture seen in liver biopsy specimens, it was in the vast majority of cases the determining factor in assigning them to this group. That in surgical jaundice the cephalin-cholesterol flocculation is negative has been repeatedly described.[1, 13, 14]

The second process to cause parenchymal liver damage in extrahepatic biliary obstruction is a superimposed bacterial infection of the portal triads. It is caused either by ascending infection through the bile ducts, or more often by the lymphogenic or hematogenic routes. Such an infection may develop during

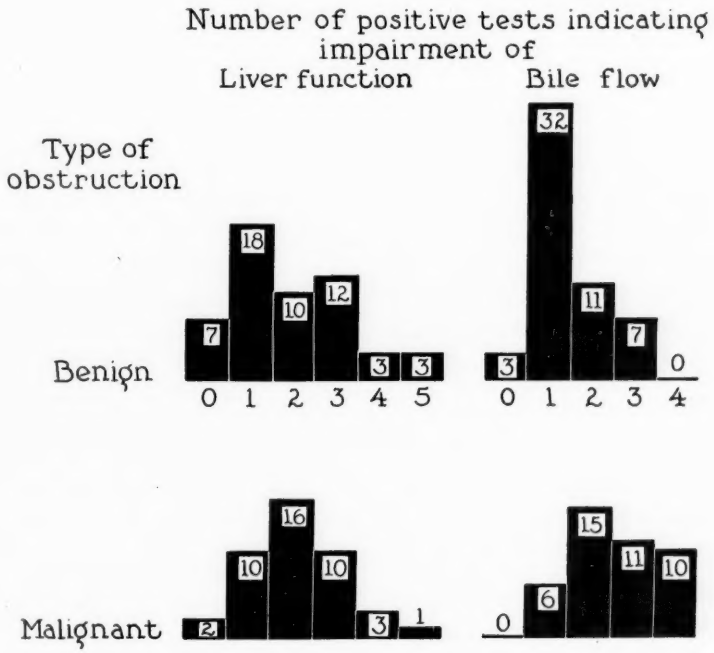

Fig. 4.—Distribution of number of positive liver function tests in benign and malignant biliary obstruction.

any stage of extrahepatic biliary obstruction and is chiefly due to inflammatory processes in the portal system. It is clinically characterized by fever, chills, sweats, leukocytosis and other evidence of septicemia. In our material 12 cases of purulent hepatitis were encountered, of which 9 belonged to the benign and 3 to the malignant group. Histologically (Fig. 3), there is a marked polymorphonuclear infiltration in the portal triads, occasionally an actual abscess formation, associated with evidence of more or less marked biliary stasis and liver cell damage. In this group almost always more than three tests denoting liver function impairment were positive. In all of them the cephalin-cholesterol flocculation was positive. Of the tests indicating impairment of bile flow, rarely more than two gave pathologic results.

Comparison Between Benign and Malignant Obstruction.—This study provided the opportunity to compare the liver functions in cases of benign biliary obstruction due to stones and scars—of which we had 53 cases—and of malignant obstruction due to carcinoma in or around the bile ducts or pancreas—of which we had 42 cases. Obviously, almost all instances of benign obstruction were incomplete and those of malignant, complete. As seen in Figure 4, in almost half of the cases of benign obstruction only one or no test indicating liver function impairment was positive, whereas far more than two thirds of the malignant cases had more than two positive tests. As expected, in malignant obstruction with low incidence of purulent hepatitis, the cephalin-cholesterol flocculation is almost always negative, whereas in benign obstruction it was positive in 13 of 53 cases. It should further be stressed that the oral hippuric acid excretion test was positive in 42.9 per cent of the malignant in contrast to 13.2 per cent of the benign group. Of the tests denoting bile flow interference, there was one or no test positive in most cases with benign obstruction, whereas in malignant obstruction usually two or more tests were positive. In malignant obstruction urobilinogen was absent from the urine more often (76.2 per cent) than in benign (50.9 per cent) obstruction. Similarly, high total serum cholesterol was found in 59.5 per cent of the malignant and in only 26.4 per cent of the benign group. The alkaline phosphatase was above 15 Bodansky units in 90.5 per cent of the malignant and in 60.3 per cent of the benign cases.

COMMENT

Reviewing the entire material, one is struck by the high incidence of cases with liver function impairment in the presence of an extrahepatic biliary obstruction, i.e., surgical jaundice. In 62 per cent of cases of surgical jaundice admitted to a general charity hospital, at least two of the tests indicative of liver cell damage were positive. Obviously, if one would have relied too much on the laboratory evidence instead of upon the clinical picture, many of these cases would have been classified as medical jaundice. The seriousness of such an error in classification is obvious.

Of the tests indicating liver cell damage the albumin/globulin ratio is most often abnormal. As mentioned before, at least two positive tests were necessary to assume liver cell damage in these surgical patients; hence, many of the other tests had to be positive in order to give such a high percentage of cases with impaired liver function. The elevation of the serum nonprotein nitrogen, the significance of which as an alarm signal in surgical jaundice has previously been stressed,[14] was present primarily in the protracted cases. It is apparently the result of the associated cholemic nephrosis, which in many respects resembles the low nephron nephrosis developing in various conditions associated with shock.[15,16] Since, however, the liver cell damage is instrumental in causing cholemic nephrosis, the elevation of the nonprotein nitrogen may be considered an indication of impaired liver function. The cholesterol-cholesterol ester ratio was not uncommonly lowered, and the hippuric acid excretion was especially reduced in malignant obstruction. The cephalin-cholesterol flocculation was positive only in a small number of cases, as will be discussed later.

Of the tests indicating bile flow interference, elevation of the alkaline phosphatase (above 15 Bodansky units) was found in 73

per cent of the cases, showing the great value of this range. If a less marked elevation (between 4–15 Bodansky units) would also have been considered, the percentage would have been even higher. However, the lower range of elevation is also found in medical jaundice and therefore is of less diagnostic value.

The fact that, as a whole, in the cases with liver cell impairment a higher number of tests indicating bile flow impairment are positive than in the cases without liver cell damage, suggests that the degree and duration of obstruction may have some bearing on the development of disturbed liver function. We make this assumption since we feel justified to consider the number of positive tests indicating bile flow or liver function impairment an indication of the degree of damage.

The liver cell damage occurring in biliary obstruction can be divided into two groups: one caused by the obstruction itself and the other by concommittant bacterial infection of the portal triads. For these conditions, the names biliary and purulent hepatitis respectively, have been used.[17] Biliary and purulent hepatitis differ not only in their histologic picture, as seen in biopsy specimens, but also in the results of the cephalin-cholesterol flocculation. The latter is usually positive in the purulent and negative in the biliary form. In general, in our material more tests indicating impaired liver function were positive in purulent than in biliary hepatitis. However, more tests indicating impaired bile flow were positive in the biliary form than in the purulent. This would indicate that liver cell damage is more marked in cases in which the obstruction is complicated by a superimposed inflammatory process. This observation emphasizes the urgency of surgical intervention in cases with obstructive jaundice, in which an inflammatory process is also present. Fortunately, however, as seen from our material, the purulent form is less common than the biliary type. Purulent hepatitis is, in general, far more common in the benign than in the malignant type of obstruction.

If the benign and malignant types of obstruction are contrasted from the point of view of the results of liver function tests, it is found that more tests indicating liver cell damage and more tests indicating impaired bile flow are positive in the malignant group. In the malignant form, urobilinogen is more often absent from the urine, the total cholesterol and the alkaline phosphatase are more often elevated and the hippuric acid excretion is more often abnormal.

Reviewing the entire material, emphasis must be given to the occurrence of liver cell damage in surgical jaundice. The demonstration of liver function impairment should not, therefore, be a contraindication to surgical intervention in patients with jaundice if other criteria warrant it. On the contrary, the presence or appearance of positive tests indicating liver cell damage in a patient with extrahepatic obstructive jaundice should be considered a strong indication for immediate surgical intervention.

In most cases with obstructive jaundice in which the demonstration of liver function impairment suggests a hepatitis, the latter will be either biliary or purulent in character. Only exceptionally, do we have reason to assume a primary hepatitis independent from the basic disease causing the obstruction. In recent years, however, a few typical exceptions to this rule have been observed, brought about by the increasing use of blood and especia of pooled plasma in patients with surgical conditions. We have learned that homologous serum jaundice may develop as late as several months after the administration of blood or blood derivatives, and that the chances of its occurrence are especially great after giving pooled plasma.[18] It is understandable that, if homologous serum jaundice should develop after an operation involving the biliary tract, the ensuing jaundice may be diagnosed as due to an extrahepatic biliary obstruction rather than to a primary hepatitis. This diagnostic error can be easily committed since in many instances homologous serum jaundice is associated with intrahepatic biliary obstruction.

SUMMARY

The results of a series of liver function tests performed in 95 cases of surgical jaundice on admission to a general charity hospital are analyzed. The tests are divided into those

indicating impairment of liver cell function and those indicating interference with bile flow. In most cases liver cell damage was found being due mostly to prolonged biliary obstruction itself (biliary hepatitis), and less often due to associated bacterial infection of the portal triads (purulent hepatitis). As a rule, more tests for liver cell damage and more tests for impaired bile flow are positive in malignant obstruction than in benign obstruction. The presence of liver cell damage, as indicated by function tests, does not contradict the diagnosis of a surgical jaundice. Moreover, if other criteria indicate the presence of an extrahepatic biliary obstruction, the demonstration of liver function impairment increases the urgency for surgical intervention.

SOMMAIRE

Les résultats d'une série d'épreuves de fonction du foie dans 95 cas de jaunisse chirurgicale admis dans un hôpital de charité sont analysés. Les épreuves sont partagées en deux catégories: (a) celles indiquant une alteration fonctionnelle de la cellule hépatique, et (b) celles indiquant une obstruction à l'écoulement de la bile. Dans la plupart des cas l'altération de la cellule hépatique était due en grand partie à une obstruction biliaire prolongée (hépatite biliaire), et moins souvent à une infection bactériénne de la triade portale (hépatite purulente). En règle générale la grande majorité des tests pour alteration de la cellule hépatique et aussi de plus grand nombre des tests indiquant une obstruction biliaire sont plus positifs pour obstruction de nature maligne que pour obstruction de nature bénigne.

Les tests indiquant un dommage de la cellule hépatique n'infirme pas le diagnostic de jaunisse chirurgicale. Si les symptomes indique la presence d'obstruction extrahépatique, il faut avoir recours a l'intervention chirurgicale.

SOMMARIO

Il risultato di una series di tasti al funzionalmento del fegato fatti in 95 casi di itterizia chirurgicale nell' ammissione ad un ospedale generale di carita sono analizzate. I tasti sono divisi in quelli indicati di deteriorazione al soffitto funzionante del cella di fegato ed a quelli indicanti ostacolo con effusione di bile. In maggioranza di casi danneggio al cella del fegato e stato trovato principalmente causato da prolungamento di ostruzione biliare da se stessa (epatide biliare) e meno spesso causate da associate bacteriale infezione alla porta triade (epatide purulente). Come regola piu tasti per danneggio al cella del fegato e piu tasti per deteriorata effusione al bile, sono positive in ostruzione malignante che in benigno ostruzione. La presenza di danneggio al cella del fegato, come e indicato da funzione di prova non contradice la diagnosi di una operazione d' itterizia. Ancor di piu, se altro criterio indica la presenza di una ostruzione traepatica biliare la dimostrazione di funzione al fegato deteriorato, aumenta l' urgenza di intervento chirurgico.

SUMARIO

Se presenta los resultados de los analisis de las funciones del hígado en una series de 95 pacientes con ictericia por enfermedad quirúrgica. Estos analisis fueron agrupados en forma tal de determinar el estado funcional de la celula hepática y el grado de obstrucción del sistema biliar. En casi todos los casos de obstrucción biliar se pudo comprobar la existencia de lesiones a las celulas parenquimatosas del hígado que fueron debidas a la obstrucción misma (hepatitis biliar) y menos frecuentemente a la infección bacteriana co-existente (hepatitis purulenta). En general mas pruebas de lesión celular hepática y de obstrucción biliar son positivas en los casos de obstrucción malignas que en los de obstrucción benigna. La prueba positiva de lesión celular hepática no contra-indica de por si el diagnóstico de ictericia quirúrgica. Aun mas la presencia de lesión celular hepática en los casos de obstrucción de los conductos biliares extra-hepáticos hace de mas urgencia la intervención quirúrgica.

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Control of Hemorrhage by Gelatin Sponge

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ONE of the most important contributions to technical surgery in recent years has been the development of the absorbable hemostatic agents. The pioneer work of Ingraham and Bailey [1] on fibrin foam; of Frantz [2] on oxidized cellulose, and of Correll and Wise,[3] Pilcher and Meacham [4] and Light and Prentice [5] on gelatin sponge has established the usefulness of these hemostatic materials in surgery.

The particular value of these hemostatic agents is that when they are applied to a bleeding area they aid in the formation of a clot. Because of their absorbability in the tissues, it is not necessary subsequently to remove these materials after the bleeding has been controlled. Thus, the possibility of resumption of hemorrhage is obviated. These hemostatic agents are not designed as a substitute for ligature or suture where this would ordinarily suffice, but rather as a supplement or alternate to ligature or suture, where this standard technic is not adequate, feasible or desirable.

The fibrin foam is prepared from human blood plasma and is a crisp light-weight foamy material, which is rather brittle in the dry state. It has most frequently been used along with a solution of thrombin, in which it is soaked just before applying to the bleeding area. When moistened, it is somewhat stronger in its physical properties.

The oxidized cellulose is prepared from gauze or cotton, which has been subjected to an oxidation process which produces cellulosic acid. The hemostatic effect is believed to be due principally to the acid reaction of this material. As thrombin is relatively inactive in an acid medium, there is no advantage in using thrombin along with oxidized cellulose. The oxidized cellulose has a texture similar to that of ordinary gauze or cotton. One distinguishing point which is rather striking is that the oxidized cellulose turns black when it comes in contact with blood.

The gelatin sponge (Gelfoam) is prepared from ordinary commercial gelatin. Air is introduced into gelatin solution to obtain the desired porosity. This is heated in an oven until dry. A crisp white material is thus obtained which can be cut into any desired size. It is packaged in glass jars, which are subjected to dry heat sterilization at 290 F. before sealing. The gelatin sponge is capable of absorbing 50 times its weight of water or 45 times its weight of blood. It is nonantigenic and nonpyrogenic. In preparing the gelatin sponge for use, it has been advocated that it be soaked in a solution of thrombin as is done for fibrin foam.

A wide range of experimental studies on dogs has been carried out to determine the absorbability [6] and hemostatic action of the gelatin sponge in the tissues. In a series of 15 wedge resections of liver tissue, the gelatin sponge applied to the bleeding liver surface controlled the hemorrhage within about three minutes.[7] In another series of 12 resections of most of a lobe of the liver, it was possible to control the hemorrhage by a "blanket" of gelatin sponge held over the stump of liver tissue for about 10 minutes [8] (Fig. 1). No thrombin solution was used with the gelatin sponge in these experiments or those which will subsequently be mentioned. It was not necessary to resort to supplementary suturing in these experiments. It was an important technical point to maintain firm pressure on the sponge covering the bleeding liver surface until the blood clotted in the sponge. When this occurred, there was apparently enough fibrin liberated to bring about an adherence of the sponge to the raw liver surface. After 20–30 minutes, the sponge could not be easily dislodged from the raw surface of the liver. If clotting occurred in the sponge before even pressure was applied over the

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entire raw surface, it was found that the bleeding might not be controlled. In this event, it was found preferable to apply a fresh sponge. In all of these experiments the animals survived the immediate postoperative period without evidence of a secondary hemorrhage. Two of the animals died, apparently from a bile peritonitis. At autopsy, the gelatin sponge was found to be firmly adherent to the liver surface, except in the two instances mentioned. There were adhesions between the gelatin sponge covering the liver surface and the surrounding organs, especially the omentum. After a month the sponge was usually absorbed. In the microscopic studies of the liver, specimens taken at various times, it was interesting to observe the rather rapid fibroplasia which developed across the stump of liver under the cover of the gelatin sponge. Furthermore, there was an invasion of the interstices of the sponge by fibroblasts from the underside of the sponge as well as the peripheral surface of the sponge. The gelatin sponge appeared to offer protective cover as well as some structural support to the healing wound of the liver. As the fibroblasts invaded the sponge, there was gradual absorption of the sponge from the surface inward. The principal factor in the absorption was apparently the action of the macrophages, although some liquefaction of the sponge undoubtedly occurred from the action of the leukocytes. Wherever there was a considerable accumulation of leukocytes, the absorption of the sponge was considerably accelerated. It was generally found that the sponge underwent complete absorption in the wounds of the liver within four to five weeks.

Fig. 1 *A*.—Profuse bleeding from liver after resection of portion of lobe shown here. Note stream of blood coming from resected stump of liver.

These experimental studies suggest that gelatin sponge would be of value in clinical surgery of the liver. In a series of 20 cases of cholecystectomy, it has been found helpful

Fig. 1 *B*.—Control of hemorrhage from liver by "blanket" of gelatin sponge applied over stump of liver, and held in place for approximately 10 minutes.

in controlling the bleeding from the gall-bladder bed on the undersurface of the liver. In some instances, it was found desirable to hold the sponge in place with several sutures to prevent dislodgement. In 10 cases of biopsy of the liver, the gelatin sponge has been useful in controlling hemorrhage. It was found preferable, however, to hold the sponge in place with mattress sutures. The gelatin sponge should be especially helpful in wounds

Fig. 2 A.—Hemorrhage from wound of vena cava.

Fig. 2 *B.*—Control of hemorrhage from wound of vena cava by application of gelatin sponge "patch" held in place for about 3 minutes.

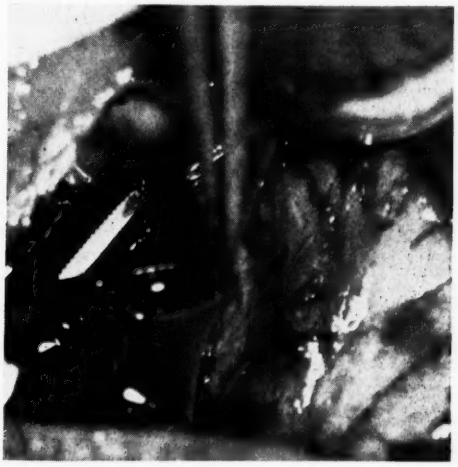

Fig. 2 *C.*—Large wound in vena cava. Bleeding has been temporarily controlled by application of rubber-covered clamps.

Fig. 2 *D.*—Gelatin sponge "patch" covering large wound of vena cava. Rubber-covered clamps removed and blood flow restored. No evidence of hemorrhage.

or resections of the liver as a supplement to the usual suture technics.

In a series of 27 experiments on dogs, a wound was made in the vena cava and the resulting profuse hemorrhage controlled by the application of a "patch" of gelatin sponge held on the bleeding vessel[8] (Fig. 2). After about three minutes, the finger pressure could be released without resumption of the hemorrhage. In three experiments, the bleeding could not be controlled by this method. In the successful experiments, the sponge remained adherent to the vein wall and effectively occluded the wound in the vessel. Immediate dislodgement was prevented by suturing a layer of tissue such as the peritoneum or pleura over the patch. In many of these experiments a small segment of vessel wall was removed to produce very copious bleeding. In studying the condition of the vein at varying periods of time after the application of the patch, it was found that a thin endothelial layer soon covered the sponge surface exposed in the lumen of the vessel. Healing progressed by invasion of the sponge by fibroblasts, which subsequently matured to an endothelialized scar as the sponge underwent absorption. There was one instance of a mural thrombus after 16 days at the site of the wound in the vein and two instances of small clots adherent to the sponge a few days after the wound was made.

This patch technic for wounds of veins may have a place in clinical surgery, particularly in instances where one would not choose to sacrifice the vein by ligation, or where vein suture may not be feasible. In resections of the pancreas or in bile duct surgery, one may injure the portal vein. This patch technic should be especially helpful in such instances, as well as in injuries of the vena cava during operative procedures such as nephrectomy, adrenalectomy, sympathectomy, removal of mediastinal tumors, or from injuries such as gunshot or stab wounds. In view of the possibility of thrombus formation, such as was observed in a few instances in the experimental procedures where the patch technic was used on the wounds of the veins, it may be desirable to use anticoagulant therapy for about a week in any clinical application of this method.

There are many instances where extensive venous hemorrhage may occur during the course of mobilizing an organ or tumor, where the gelatin sponge may be helpful in controlling the hemorrhage until the structure has been removed, thus permitting adequate exposure of the bleeding areas, which could then be handled by ligature or suture. Furthermore, the gelatin sponge may have a place as a first aid dressing for superficial vein injuries, such as the jugular vein, or for rupture of varicose veins.

In another series of 17 experiments on dogs, a through-and-through wound was made in the aorta with a scalpel.[9] The massive hemorrhage from the vessel was first controlled by the application of rubber covered bull dog clamps. A "cuff" of dry compressed gelatin sponge was then wrapped about the vessel and supported by a sheath of chromic catgut, which was then held in place by several sutures of chromic catgut tied around the sheath. It was important to avoid constricting the lumen of the vessel during the application of the cuff and sheath. The bull dog clamps were then released, the hemorrhage was controlled and the blood flow restored in each instance. There were two subsequent "blowouts," one propagating thrombus and one aneurysmal sac formation in this series. In the successful experiments, the vessel wall healed over by an endothelialized scar, and the gelatin sponge and chromic catgut sheath ultimately underwent absorption.

The practical significance of this phase of the experimental work may not be so much in the direct application of this method to injuries of arteries, but rather as a supplementary method which could be used to reenforce a suture line in an arterial wound or an arterial anastomosis. There is a possibility that this method may have some usefulness in surgery of aneurysms to provide a reenforcement in some cases where more radical surgery may not be feasible. The important feature of these experiments is that arterial hemorrhage of major magnitude has been controlled by a hemostatic agent without resorting to suture or ligation. However, this was made possible only by an absorbable supporting structure, the chromic catgut sheath.

In another series of 15 experiments on dogs, a wound was produced with a scalpel in the

right or left ventricle of the heart [10] (Fig. 3). In some instances the wound was made large enough to admit the tip of a finger. A "patch" of dry compressed gelatin sponge was applied over the wound and held in place for 3–5 minutes for the right ventricle, and 5–13 minutes for the left ventricle before the hemorrhage was controlled. The patch became increasingly adherent to the heart, so that after 20–30 minutes it was often difficult to remove it. In some instances, it was necessary to apply a second patch, if the first one did not completely control the bleeding. There were six other experiments in which the animal died of ventricular fibrillation when the pericardium was opened or the wound produced; these could not be used to evaluate the effectiveness of the gelatin sponge. In the 15 successful experiments, the animal survived the immediate postoperative period, and there were no instances of secondary hemorrhage. The pericardium apparently offered sufficient support to prevent "blowouts" in the left ventricular wounds, where the pressure might be expected to be sufficient to dislodge the patch.

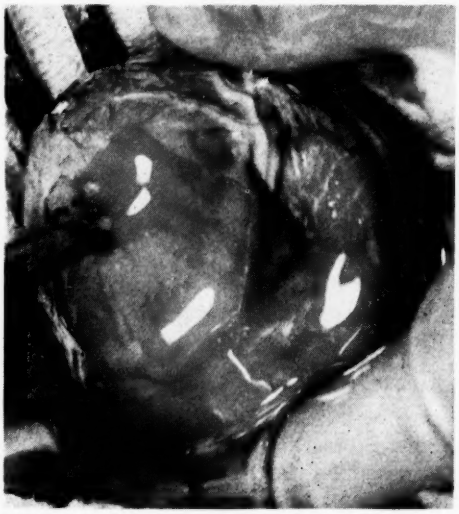

Fig. 3 *A*.—Wound of left ventricle of heart produced by scissors introduced into cardiac chamber. Considerable bleeding from wound which covers scissors.

In an additional series of 18 experiments, a wound was made with a scalpel in the cardiac auricles, or a portion of the auricular appendage was excised. [11] This produced rather copious hemorrhage, which was controlled by the application of a gelatin sponge patch for about 10 minutes. In two experiments it was necessary to resort to suture. There were no instances of secondary hemorrhage in this series. There were three instances of intracardiac thrombosis in the combined heart experiments.

The control of hemorrhage from wounds of the heart by this patch technic should have some practical value in the surgery of penetrating wounds of the heart. The gelatin sponge should be helpful in obtaining immediate hemostasis when the pericardium is opened, so that sutures could subsequently be placed in a relatively dry field. The sponge could also be used to reenforce a suture line which may not have completely closed the wound in the heart. In small wounds or in wounds near a coronary vessel, it may be feasible to resort to the gelatin sponge patch alone. The use of the sponge as a pad which is held over the wound by sutures may also be of value in some cases. Two instances where the gelatin sponge has been used as a

Fig. 3 *B*.—Gelatin sponge "patch" applied to wound of heart. It usually requires 5–13 minutes pressure on the "patch" before it becomes adherent to the heart and controls the hemorrhage from the left ventricle.

supplement to suture in wounds of the heart have been reported by Brown.[12] Other cases will be reported by Maguire.[13] Other uses for the sponge may occur if there is an injury of the cardiac auricles during the course of a pericardiectomy, or possibly as a means of controlling hemorrhage from coronary vessels. The most interesting point is the possibility of utilizing the gelatin sponge to facilitate the control of hemorrhage in intracardiac surgery, such as for stenosing lesions of the valves or foreign bodies.

The fact that hemorrhage from large wounds of the heart could be controlled with the gelatin sponge alone is an excellent test of the effectiveness of this hemostatic agent. The clinical application of this experimental study has innumerable possibilities, wherever there is a problem in controlling hemorrhage. In ordinary epistaxis we have found the gelatin sponge a convenient method of treatment. Cope [14] has reported a series of cases where this agent was helpful in controlling nosebleeds. In rectal surgery the gelatin sponge makes a very satisfactory pack. In instances of postoperative hemorrhage after hemorrhoidectomy it may be especially valuable. Rosser [15] has reported a series of cases where the gelatin sponge or oxidized cellulose was used as an hemostatic dressing in anorectal surgery. The bleeding following tooth extraction can be easily controlled by a small piece of gelatin sponge; furthermore, the gelatin sponge helps to keep food particles out of the tooth socket.

The gelatin sponge has been used in 20 cases of thyroidectomy, 3 cases of biopsy of the thyroid gland and 2 cases of removal of thyroglossal sinus. It serves a purpose as a supplement to ligature or suture; however, one should be cautious about using very much of the gelatin sponge where there are a large number of ligatures. The catgut produces enough leukocytic response in the tissues to hasten the liquefaction of the gelatin sponge, thereby producing what may appear to be a more noticeable serum reaction in the wound. If the gelatin sponge is used to supplement hemostasis where silk or cotton has been used, it is possible that it may occasionally contribute to the formation of a draining sinus from which the silk or cotton ligatures may ultimately extrude. It would be advisable that the use of the gelatin sponge be reserved for such cases where the residual bleeding after ligature or suture is menacing from the standpoint of serious hematoma formation, or for bleeding in proximity to the recurrent laryngeal nerves which might be damaged if a ligature or suture were used.

Another field of usefulness for the gelatin sponge is in extensive radical resections of malignant tumors. Here there may be a continual loss of blood during the course of dissection, which can be controlled at least to a considerable extent by gelatin sponge. Thus, it would be possible to do some of these more extensive procedures without having to give so many blood transfusions during the operation.

The mode of action of the gelatin sponge revolves about the normal mechanism of hemostasis of the body. In the first place, the sponge acts to a considerable extent as a tampon, which slows or stops the flow of blood, thus permitting the clotting mechanism of the blood to become more effective. As the blood enters the sponge interstices, it is probable that the platelets become damaged by contact with the walls of the interstices, thereby liberating thromboplastin. This, along with clot-promoting substances liberated in the tissues combining with the calcium and the prothrombin in the blood, produces thrombin, which in contact with the fibrinogin produces the fibrin clot. The clotting of the blood in the sponge and the adherence of the sponge to the wound due to the liberation of fibrin produces essentially a "reenforced clot." This reenforced clot serves to control the bleeding until healing occurs under the protective cover of the sponge. It also serves as a lattice work for the growth of fibroblasts, producing some additional structural support to the healing wound. The gelatin sponge undergoes absorption with nominal tissue reaction after the hemorrhage is controlled and the wound is healed.

In this experimental study, the gelatin sponge was used without the addition of thrombin, so that a clearer understanding could be obtained regarding the role of the sponge itself. There can be no doubt but

that the principal factor in the control of hemorrhage is the spongy nature of the material itself. The addition of thrombin undoubtedly aids the rate of clotting, but it was difficult to assay the extent to which it did so. For any conditions in which there may be a defect in the normal clotting mechanism, such as a deficiency of prothrombin or platelets, one should of course resort to moistening the sponge in thrombin solution. Until such time as the role of the thrombin can be further clarified, it would probably be better to use thrombin along with the gelatin sponge in most clinical cases.

There are a number of technical points in the use of gelatin sponge which can be best described as "know how," which are essential for the successful use of this material. One must gain some personal experience in handling this hemostatic agent, before attempting to use it for the control of severe hemorrhage. It may be prepared for use by soaking in saline solution, with or without thrombin, or by compressing it in the dry state. In the more critical experimental tests it was used as a dry compressed sheet. The principal points in technic are: To apply firm, even pressure over the sponge as soon as enough blood has escaped to saturate the sponge; to maintain the pressure until the blood clots in the sponge; to remove the pressure without having the sponge stick to the gloved fingers or to whatever is used to maintain the pressure. In the dry state, the gelatin sponge sticks to the rubber gloves, unless they are moistened just before applying the sponge. Perforated cellophane or perforated Cilkloid was found to be especially helpful in preventing the sponge from sticking to the gloves. The cellophane or Cilkloid is then removed from the sponge by applying a saline soaked sponge over this material, which permits the saline to penetrate the perforations, soften the sponge and permit easy removal. One should, of course, be especially careful not to leave the cellophane or Cilkloid in the wound.

SUMMARY

In experimental studies on dogs, the gelatin sponge was used to control hemorrhage from wounds of the liver by the "blanket" technic; the aorta by the "cuff" technic; and the vena cava and the heart by the "patch" technic.

The effectiveness of this hemostatic agent alone under these rather critical experimental conditions demonstrated its potential value in clinical surgery.

The careful and judicious use of gelatin sponge should provide the surgeon with a useful technical method for controlling hemorrhage where ligatures or sutures may not be adequate, feasible or desirable.

Clinical observations which have thus far been made support this view.

SOMMAIRE

Dans des expériments sur des chiens on employa pour contrôler l'hémorrhagie des plaies hépaliques l'épouge de gélatine sous farme de couvertures; pour les l'hemorrhagies de l'aorte sous forme de manchettes; pour les hémorrhagies de la veine cave et du coeur sous forme de rapiécage.

L'efficacity de cet agent hémostatique dans des conditions sérieuses experimentales démontre sa valeur potentielle dans la chirurgie clinique.

L'emploi soigné et judicieux de l'éponge de gélatine met à la portée du chirugien une méthode où la ligature ou la suture sont insuffisantes ou impraticables.

Des observations cliniques supportent ce point de vue.

SUMARIO

En experimentos en perros, el uso de las esponjas de gelatina son muy efectivas en el control de las hemorragias producidas por heridas provocades del hígado, aorta, vena cava inferior, y corazón.

El uso judicioso de las esponjas de gelatina en el control de las hemorragias es practico y deseable en los casos en que no es posible controlarlas por liguaduras; como ha sido demostrado en la clínica.

SOMMARIO

Nei studi esperimentali su cani, la spugna gelatina e stata usata per controllare l' emorragia da ferita al fegato dalla tecnica "coperta" quella della corta della "fascitura" e quella della vena cava con la tecnica della "impaccatura."

Il modo effettivo di questo agente di stanazione solo sotto queste condizione di critico esperimento hanno dimostrato la valuta potenziale nella clinica chirurgica.

L' attento e guidizioso uso della spugna gelatina provvede al chirurgo con effeto questo metodo tecnica per il controllo d' emorragia dove legatura o saturazione forse non sono adequate praticale o desiderabili.

Le osservazioni clinichi di cui siu ora sono state fatte supportono questa veduta.

Свод

В опытах над собаками желатиновая губка была употреблена для контроля кровотечения: в ранах печени был употреблен "покровный" способ; аорты — "манжетный" способ, а в vena cava и сердце — "заплата".

Потенциальная ценность этого гемостатического агента в клинической хирургии была демонстрирована его эффективностью при этих довольно критических экспериментальных условиях.

Осторожное и рассудительное применение желатиновой губки дает хирургу полезную техническую методу контроля кровоизлияния, где лигация или швы не являются адективными, возможными или желательными.

Клинические наблюдения поддерживают этот взгляд.

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Direct Anastomosis Between a Pancreatic Cyst and the Intestinal Tract

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IT might seem superfluous to discuss the surgical treatment of pancreatic cysts, on which so much work has been done. However, a series of new operations has been developed, and their value and justification still remains to be assessed. This applies particularly to the direct anastomosis of the cyst with the proximal portion of the intestinal tract. By virtue of their simplicity and the excellent results achieved, these operations appear to constitute a great progress in pancreatic cyst therapy. Nevertheless, warning voices are still audible, based on serious theoretical assumptions. It is, therefore, not surprising that most surgeons still prefer the well established route, however arduous it may be. The extremely rare occurrence of pancreatic cysts and the consequently small number of operations performed, present a great difficulty in the evaluation and comparison of the various operative methods. As a point of interest I might quote Aronsson, 1940, according to whom world literature mentions altogether some 500 cases of pancreatic cysts. Since then 63 patients have been operated on in Sweden. The Mayo Clinic had 22 cases within 5 years, 1935–1939. I know of 31 cases in Czech literature, 10 of which were operated on at our surgical department.

Prior to the discussion of my own experiences I should like to review surgical treatment in general, so as to point out the considerable contribution of Czech surgery to this question. Nowadays three operative methods are being used: (1) complete removal of the cyst; (2) Gussenbauer's marsupialization, recommended in 1882; (3) various anastomoses of the cysts with the intestinal canal or gallbladder.

The complete removal of the cyst has been wrongly considered the ideal solution. The operation is technically arduous because of its extent, it always causes considerable injury to the gland and profuse hemorrhage, and taxes the already exhausted patient too heavily. It is also accompanied by a high mortality rate of 10.7 per cent (Guleke, Goebell) which increases to 55.5 per cent (Gross, Guleke, Küttner), if the intended extirpation of the cyst proves impractical during the operation. Neuffer assesses the mortality rate at 50 per cent. The greatest drawback of this operation is the fact that in many cases, when the cyst is enclosed by major adhesions—as is the case in pseudocysts—its radical performance is technically impossible.

Marsupialization has still the greatest number of advocates, probably because of its simplicity. The results are on the whole satisfactory, but the formation of a stubborn pancreatic fistula is a frequent complication, which may prove a grave torment to the patient and a hard technical problem to the surgeon. The large amount of juice secreted over a long period damages the surrounding tissues, causes inflammations and secondary infection of the cyst and hemmorrhage or even malignant growth. Serious loss of pancreatic juice may also lead to grave inanition. Exner and Körte described even fatal cases. The mortality rate amounts to about 4–5 per cent (Rössing).

Fistulas which persisted despite dietetic treatment, excision or cauterization, gave birth to the idea of converting a fistula into a sinus by anastomosing it to the proximal part of the intestinal canal. Chronologically, Kehr was the first who anastomosed a pancreatic fistula to the gallbladder and this in turn to the stomach. Ombrédanne performed, in 1911, the first direct pancreatocystoduodenostomy, but his patient died on the eleventh day. In 1922, Rudolf Jedlička published his new suggestion of primary anastomosis be-

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tween a pancreatic cyst and the stomach. He called the operation, which he already performed successfully in 1915, pancreatogastrostomy. The operation consists of the isolation of the stem of the cyst, the so-called infundibulum, its transstomachal anastomosis to the posterior gastric wall, with external drainage of the rest of the cyst. Jedlička was guided by the impracticability of successful removal of pseudocysts, as well as by the generally recognized unsatisfactory course of healing following marsupialization. Jedlička's operation arose independently of his predecessors, and it is also recognized abroad as a pioneer achievement. His original technic has never been used since. The location and separation of the infundibulum is difficult and frequently impossible. Either the stem does not exist or it is so thin-walled that it cannot be utilized for the anastomosis as proved in David's first case. The principal idea, however, anastomosis into the gastro-intestinal tract, proved correct as later confirmed by others. The technic was altered in so far as to proceed in two stages, as already previously practiced by Doyen and Michon. The cyst is first marsupialized, and only in the second stage is the fistula connected to a portion of the gastro-intestinal tract. This idea was carried out, with many anatomic and technical variations, in a long series of cases. A record of them can be found in David's and Kafka's works. The advantage of both of these works lies in their exact terminology, which is most important for the correct evaluation of the various technics. Above all, one must differentiate primary from secondary anastomosis, i.e., the connection of cyst or pancreas from the secondary connection of a pancreatic fistula to the alimentary tract.

In Czechoslovakia, Polák was the first to operate in 1932, 17 years after Jedlička, a pancreatic ranula, which probably developed following a gastric resection after Péan-Rydygier through ligation of the accessory pancreatic duct. He marsupialized the cyst in the first stage, and three years later he connected the fistula and its pancreatic portion to the posterior wall of the stomach, thus performing a kind of secondary pancreatogastrostomy. In 1935, Polák operated on a second case in three stages. In the first stage he marsupialized the cyst, in the second he connected the fistula to the stomach. The fistula, however, recurred and healed only in the third stage, when he anastomosed it to the jejunum by Hahn-Hohlbaum's method. In 1936, David reported his three cases of pancreatic cysts. In his third case he came nearest to Jedlička's operation. This patient had a pseudocyst following acute pancreatic necrosis. He implanted the base of the cyst, containing the orifice of the pancreatic duct, into the posterior wall of the stomach, then packed the rest of the cavity and connected it with the surface by a small opening through the abdominal wall. In 1940, Kafka published his two cases. In his second case he performed, one year after marsupialization, a pancreatofistulojejunostomy after Montprofit. In 1941, Diviš also successfully performed a two-stage operation on a pancreatic cyst.

All such secondary anastomoses present considerable technical difficulties, because of extensive adhesions in the field of operation as well as the cicatricial character of the fistula, and the results are frequently doubtful. Moreover, they impose unnecessarily heavy demands on the patient, already weakened by the fistula. Also these operations miss the original aim sought by Jedlička with his operation, namely to avoid fistula formation.

Jedlička's idea of primary anastomosis of the cyst with the stomach was materialized in a somewhat altered form by Jurasz in 1929, who then published his operation in 1931. He operated successfully on two patients. His operation consists of a wide connection of the cyst with the posterior gastric wall by the transstomachal route. Similar to Jurasz, Kerschner in 1929 opened a pseudocyst transduodenally into the posterior wall of the duodenum. Apart from these operations, other direct anasotmoses were designed and, on several occasions, successfully performed. Hahn in 1923 opened a cyst into the jejunum, and Walzel in 1925 connected a cyst with the gallbladder, etc. At Polák's clinic we performed direct anastomosis of a cyst with the alimentary canal four times on three patients within a short period. One patient had a double cyst. We came to use the method by

TABLE I

PANCREATOCYSTOGASTROSTOMY

	Author	Year of Publication / Year of Operation	Description of Operation	Result
1.	Jurasz "	1931 1929	Primary, transstomachal—P.	Healed, revision 10 months after operation.
2.	Jurasz "	1931 1930	Same performance—T.	Healed.
3.	Harries	1934	Secondary, after unsuccessful drainage—P.	Healed, revision 3 weeks after operation.
4.	Vecchi Gold	1935 1931	Primary anastomosis with anterior wall of stomach.	Healed, revision 3 years after operation.
5.	Hara	1936	Primary transstomachal—P.	Healed, revision 7 weeks.
6.	Kafka "	1939 1936	Posterior primary—P.	Died on 12th day of hemorrhage.
7.	Orator "	1939 1939	Pancreatocystogastrostomy after pancreatocystocholecystostomy.	Healed.
8.	Maske "	1941 1940	Primary transstomachal—T.	Healed, revision 4½ months after operation.
9.	Erdély "	1941 1940	Primary transstomachal—P.	" " 5 months
10.	Hortolomezi	1941	Primary transstomachal—P.	"
11.	Rössing König	1942 1942	Primary posterior—T.	"
12.	Henrich	1942	P.C.G. after G.E.A.—T.	"
13.	Kunc "	1944 1944	Primary transstomachal—P.	" " 4½ months
14.	Kunc Polák	1944 1944	Primary transstomachal—P.	" " 3 months
15.	Kunc	1944	Primary transstomachal—P. There was a double cyst. See no. 7, Table II.	" " 2 months

P = pseudocyst. T = true cyst.

sheer coincidence, since in the first case the pseudocyst adhered so firmly to the neighboring tissue that we had no other choice. The exceedingly smooth postoperative course and the excellent result encouraged us to abstain from marsupialization and secondary anastomosis in the following cases too, and to try direct anastomosis with the stomach.

CASE REPORTS

Case 1.—F. V., aged 51, was admitted on Mar. 16, 1944. His family history was irrelevant. In October, 1943, he had had cholecystitis, and roentgen examination at that time revealed afunction of the gallbladder. The present illness began some eight weeks before admission, with severe pain under the left costal margin and temperature of 100 F. For the first fortnight, he vomited after each meal, and the pain subsided only after the stomach was empty. Since then he complained of incessant disagreeable pressure in the epigastrium and under the left costal margin and of a permanent sensation of overeating. He had severe meteorism.

He was of adequate musculature and normal build. Temperature at examination was normal, blood pressure 120/80, urine normal, blood sedimentation rate slightly raised, Wassermann reaction negative. There were 4,120,000 erythro-

TABLE II

PANCREATOCYSTODUODENOSTOMY

	Author	Year of Publication / Year of Operation	Description of Operation	Result
1.	Ombrédanne	1911	Ca of papilla with retention cyst.	Died on 11th day after operation.
2.	Kerschner	1929	Primary transduodenal after G.E.A.—P.	Died on 7th week after operation of T.B. pulm.
3.	Kerschner	1935	Primary transduodenal and cholecystectomy—P.	Healed, revision 1 year after operation.
	"	1935		
4.	Józa	1936	Into anterior duodenal wall, traum.	" " 4 months
5.	Vuori	1936	Secondary G.E.A.—One year after fistulogastrostomy—P.	Healed.
6.	Dobay	1939	Transduodenal, primary.	"
7.	Kunc	1944	Transduodenal, primary—P. On the same patient as on Table I, **no. 15.**	Healed, revision 2 months after operation.

P = pseudocyst.

cytes, 94 per cent hemoglobin, color index 1.14, leukocytes 6,200, neutrophils 56, eosinophils 2, lymphocytes 34. The abdomen is level with the chest, soft and painless. A spherical, painless resistance is palpable deep in the epigastrium, to the left of the midline. The patient states that this tumor varies in size, sometimes being visible, with bulging of the abdomnal wall, at other times so small that he cannot feel it.

On Mar. 10, roentgen examination (Dr. Mašek) showed a free esophageal passage and a hook-shaped stomach with its lower pole level with the iliac crest (Fig. 1). At the center of the stomach was a filling defect the size of the palm of the hand, with sharp edges, narrowing the lumen of the stomach medially and dorsally. The gastric and duodenal mucosa showed no other marked changes. Two hours after the meal the stomach was practically unchanged. Tentative diagnosis was extragastric tumor, most probably derived from the pancreas.

On Mar. 22, I performed a supra-umbilical midline laparotomy under ether anesthesia. The walls of the stomach were soft. At its proximal side it was displaced anteriorly by a spherical smooth tumor, a cyst originating in the tail of the pan-

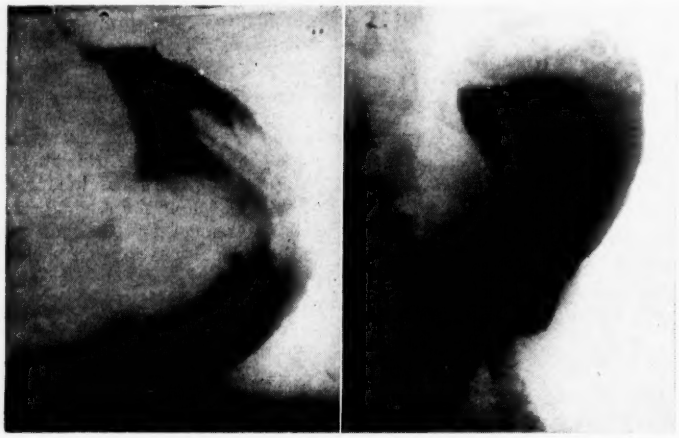

Fig. 1 *(left).*—Case 1, before operation. **Fig. 2** *(right).*—Same case, after operation.

creas. It was firmly adherent to the posterior ventricular surface as well as to the other neighboring tissues, so that its mobilization was out of the question. To gain sufficient access to the cyst, which was placed fairly laterally, the wound had to be enlarged through a transverse incision to the left. Then the anterior wall of the stomach was divided transversely, and the cyst evacuated by a puncture through the posterior ventricular wall. Seventy-five cc. of bluish, slightly turbid liquid were obtained. The posterior wall of the stomach with the firmly adherent wall of the cyst were then incised transversely for about 5 cm.; thus a wide anastomosis with the stomach was established. The cystic cavity was situated near the upper border of the pancreas; it was approximately spherical, with smooth yellowish walls. At the base a necrotic area was found. The wall was firm and about 1 cm. thick. No concrements or calcifications were found anywhere within the pancreatic tissue. The wound edges in the cystic and gastric walls were stitched together with a continuous catgut suture, for hemostatic purposes, since the cystic cavity, after being opened, had no connection with the abdominal cavity. The anterior stomach wall was then sutured in three layers, and the laparotomy wound closed.

Biopsy examination of the section of the gastric wall (Dr. Stolz) revealed a chronic atrophic inflammation of the mucosa and a sclerohyperplastic inflammation of the submucous and muscular layers. The mucosa contained numerous metaplastic intestinal glands. In one place a beginning peptic ulceration was seen, causing perigastric hyperplastic changes, partly with fibrinopurulent coating. The cystic wall itself contained no epithelial lining or any residual pancreatic tissue, and it was formed purely of new connective tissue. The material labelled as the contents of the cyst was connective tissue partly digested, in some places autolytic disintegration of the tissue, in others revealing cellular infiltration of the connective tissue and fibrinous exudation. The cystic body within the pancreas may be looked upon as a pseudocyst originating in a necrotic process within the gland.

The postoperative course was uneventful, except for a small hematoma in the wound. Immediately after operation the patient was relieved of all symptoms. The stitches were removed on the tenth day. On the eleventh day after operation, the patient was discharged.

An x-ray control of the stomach was performed before he left (Dr. Dulík). This showed the stomach of normal tone, on the whole cylindrical, the fornix forming a mild cascade. The lower pole reached two fingers' breadth above the iliac crest. In the middle part there was a slight hour-glass deformity, the greater and lesser curvatures as well as the anterior surface being slightly retracted. On the posterior surface—and more so in the supine posture—there was at the site of the former hemispherical impression a marked filling defect about 1½ cm. deep and 4 cm. in diameter; its edges were ill defined but not rigid, curving visibly with each transferred respiratory excursion. The gastric mucosa appeared normal; the outlines of the contrast meal were smooth. The pylorus and duodenal bulb were drawn to the left, otherwise the duodenum was normal. Three hours after the meal both stomach and duodenum were empty, the barium filling the lower ileal loops.

Conclusion: The pancreatic cyst was greatly reduced in size, but the opening seemed to be occluded, since not the smallest barium particle had reached the cyst. At the site of the previous operative interference on the stomach retractive adhesive changes were noticeable.

Another x-ray examination was done on Aug. 2, 1944 (Dr. Dulík). The filled stomach (Fig. 2) was funnel-shaped, somewhat shortened in its long axis, reaching two fingers' breadth above the iliac crest. The mucosal pattern was hardly noticeable, the outlines of the barium being smooth. The pylorus and duodenum were unchanged. Compared with previous examinations, the mucosal pattern was almost absent (atrophic gastritis); otherwise there were only signs of retractive changes. Neither the presence of the cyst nor any opening into it could be seen. To gain more accurate information about his general condition, further investigations were made. Fasting blood sugar was 94 mg. per cent; gastric juice examination revealed a histamin-resistant achylia. There were 5,120,000 erythrocytes; 113 per cent hemoglobin; 1.10 color index; 6,200 leukocytes; polymorphonuclears, 42; reticulocytes, 7; eosinophils, 4; basophils, 1; lymphocytes, 42; monocytes, 4.

The faulty gastric secretion in this patient cannot be classified as a result of the operation, since histologic examination of a section of the gastric wall revealed a severe atrophic gastritis with a sclerohypertrophic inflammation of the submucous layer. It was therefore a concomitant condition. The pancreatic cyst may be regarded as completely healed. The patient has no more complaints, his appetite is excellent and he has gained over 20 lb. since discharge. He was also relieved of the trying constipation which tormented him during his illness. As he had once since the operation a typical biliary colic with high temperature, we advised him to have his gallbladder removed at some future date, for it is most likely

that the pancreatic pseudocyst developed from an acute pancreatic necrosis resulting from a diseased gallbladder.

Encouraged by the good results of primary anastomosis in this patient, we undertook the same operation in another pancreatic cyst of much larger dimensions.

Case 2.—Z. R., female, aged 45, was admitted Apr. 30, 1944. On June 6, 1943, she was seized with violent epigastric pain and severe vomiting. During the following days a mild jaundice set in, which cleared up. From then on she never enjoyed full health, since the attacks of pain recurred from time to time, although they were less severe than the first one. She dieted herself. On Mar. 2, 1944, another attack was so severe that she was admitted to the hospital at Kolín. After three weeks' hospitalization, a tumorous body appeared in the epigastrium, which grew progressively and was eventually diagnosed as a pancreatic cyst. In mid-April however, this cystic body suddenly disappeared, and she was consequently discharged. On April 30 she appeared at the Vinohrady hospital with renewed complaints. She felt severe pressure in the epigastrium, aggravated in the horizontal posture, and accompanied by frequent nausea. Severe vomiting followed each meal, and during the past few

Fig. 3.—Case 2, before operation.

days she would not even digest liquid food. She lost weight heavily.

The patient was of higher build, skeletal and muscular development adequate, nutrition poor. The temperature was normal. Urine was normal.

The abdominal wall bulged in the epigastric region with an underlying smooth, soft tumorous body, about the size of a child's head. This body was fixed to its base, and slightly sensitive on palpation. The abdominal wall was freely mobile against the tumor. Urine diastase May 1 was 252 units after Wohlgemuth.

X-ray examination of the stomach (Dr. Dulík) on May 2 revealed free esophageal and cardiac passages (Fig. 3). At its lower half the stomach was displaced to the left and down, around a tough palpable central resistance situated above the lesser curvature. The mucosal folds appeared generally regular. The lesser curvature on the dislocated part of the stomach was not clearly defined and could not be separated from the resistance. In the lateral view the stomach was immediately behind the abdominal wall. Peristalsis was poorly marked, the pylorus was patent, the duodenal bulb was conical and filled well, but emptying here as well as in the descending duodenal portion was deficient. Only sporadically did the meal pass into the intestinal coils, but there was no evidence of any widening of the duodenum. Three hours after the meal there was a fine mucosal film within the stomach, and the rest of the barium was within the small intestine and in the colon down to the middle of its descending portion. The transverse colon showed a displacement corresponding to that of the stomach. Apparently we were dealing with an expansive process within the pancreatic body (tumor? cyst?).

Cholecystography showed that 17 hours after the injection the gallbladder remained invisible. Afunction of the gallbladder was present. The conclusion was a pseudocyst of the pancreas, probably following acute pancreatic necrosis from a diseased gallbladder.

Operation was done May 9. Under ether anesthesia the abdomen was opened in the midline above the umbilicus. A cystic body was situated in the region of the lesser omentum by which it was covered, displacing the stomach downward and forward. The cyst, the size of a child's head, arose clearly from the body of the pancreas. It adhered lightly to the omentum, and broadly to the posterior ventricular surface, which was detected after partial separation of the lesser omentum from the cystic surface. The stomach was opened through the anterior wall, whereupon the posterior wall was opened transversely by cautery to the extent of 3 cm.; through this opening 3 L. of a thin brown liquid were evacuated from the cyst. Thereafter the wall of the cyst was fixed all round to the posterior gastric wall with continuous catgut suture, and the anterior gastrotomy was closed.

The postoperative course was uneventful, without pyrexia or vomiting. To prevent any accumulation of gastric contents within the cystic cavity, the patient was advised to lie on her right side.

The diet was rigidly restricted to a few spoonfuls of tea up to the third day, liquids being administered by saline with glucose infusions. For the following five days a normal amount of liquids was given by mouth, and from the eighth day semisolid food was allowed, soon succeeded by a normal diet. The patient was rid of all complaints since operation. On the day after the operation the cyst was no longer palpable. On the eighth day the wound was healed.

On the thirteenth day after operation Dr. Dulík carried out an x-ray control of the stomach. The deformity at the lower pole of the stomach, caused by the cyst, had disappeared completely. The full stomach had the shape of a rectangular hook with the lower pole somewhat above the iliac crest. The mucosal folds in the lower half of the stomach and above the angular notch showed a somewhat irregular and convergent course (Fig. 5). The antrum was spasmodically contracted throughout the examination and only infrequently, with major peristaltic waves, did it expand slightly. Peristalsis began high up on the stomach and ran down to the pylorus in deep symmetrical waves of a stenotic type; the pyloric passage was free. The bulb and the rest of the duodenum were unchanged. Within three hours the meal filled the lower ileum, coecum and the ascendent colon.

The conclusion was reached that the connection from the stomach into the cyst was occluded. The deformity had disappeared; there was considerable irritation of the antrum and some retractive changes. On May 27 she was discharged. Control examination on Aug. 8 showed her symptom-free without dieting and a gain of 28 lb. The abdomen appeared normal, the cyst completely disappeared. Fasting blood sugar was 68 mg. per cent. Gastric juice acidity was normal; free acid 40 minutes after 0.5 histamin was 6 r, total acidity 73, with slight hypersecretion.

X-ray control (Fig. 4) showed the filled stomach hook-shaped, of normal tone, the lower pole reaching the level of the iliac crest. Outlines of the contrast meal were smooth. The mucosal folds in the lower half were arranged in starshaped fashion (Fig. 6), and the lesser curvature here was somewhat retracted. Otherwise the mucosal arrangement was quite regular. Peristalsis began slightly above the incisura angularis, and proceeded undisturbed in symmetrical waves down to the pylorus, which was patent. The bulb and rest of the duodenum were unchanged. There was no leakage of the barium outside the stomach. Thus the x-ray findings were absolutely normal.

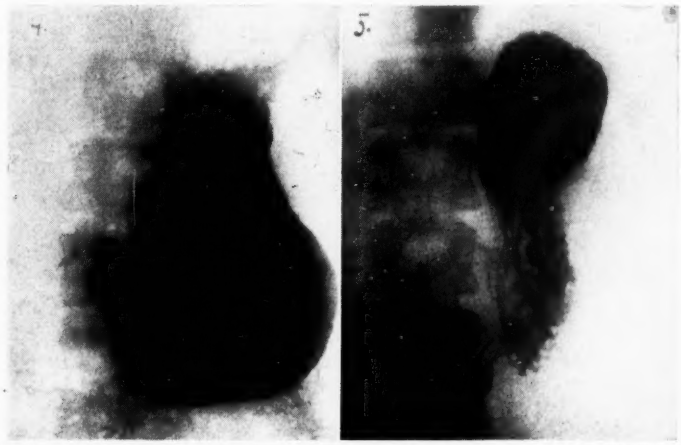

Fig. 4 *(left)*.—Same case as preceding. Fig. 5 *(right)*.—Same case, showing mucosal pattern 13 days after operation.

Case 3.—The findings and operation on this last patient are particularly interesting and possibly altogether unique in literature.

R. T., male, aged 40, was admitted for operation on June 9, 1944. In March, 1944, the patient was seized with violent epigastric pain accompanied by severe vomiting. He was hospitalized for 14 days at a provincial hospital. Ever since, he suffered from lasting pain and a feeling of fullness in the gastric region. On May 27, he was admitted as suspected appendicitis, two days later he had rightsided pneumonia. After his recovery, operation was recommended for the pancreatic cyst, found as a concomitant condition. The patient was of strong build, considerably debilitated.

Wassermann reaction was negative. Blood count was erythrocytes, 3,980,000; leukocytes, 7,300; reticulocytes, 7; polymorphonuclears, 73; lymphocytes, 18; blood sedimentation rate, Westergreen, 1 hr. 110, 2 hrs. 120, average 85; blood pressure, 115/65.

The epigastrium bulged with two large spherical tumors which were smooth, immobile and painless. One was situated beneath the right costal margin, as large as a child's head. The other filled the space between xiphoid, umbilicus and splenic region. Whether or not there existed a connection between these tumors was undetermined.

A film, covering only the right epigastrium, made June 5, showed the barium meal within the lower half of the stomach, duodenum and adjacent jejunal loops. The antrum was broad and somewhat displaced upward, the pylorus was ill defined. The barium proceeded in a wide flow into the enlarged duodenal bulb, which curved down. All duodenal portions were clearly enlarged, and the duodenum was horseshoe-shaped. In its distal portion the mucosal folds were marked. It was concluded that we were dealing with an extensive process in the head of the pancreas, possibly a cyst.

Operation was done June 12. Under ether anesthesia a medial epigastric laparotomy was performed. The stomach was displaced up and to the right by a cystic body which filled in the entire epigastrium and left hypochondrium. The proximal portion of the posterior surface of the stomach was free and only the prepyloric portion was connected to the cyst. The cyst clearly originated in the pancreatic body and tail. Within the pancreatic head another cystic body was situated, somewhat smaller than the first, which expanded the duodenum and displaced it far to the right side. The duodenum was completely flattened. This cyst filled the entire subhepatic region and reached down below the umbilicus. Having found the left-sided cyst adhering to the stomach, we opened the latter through a transverse incision in the prepyloric portion of the anterior surface, and established a connection, 4 cm. wide, with the cyst through the posterior wall. The cyst contained 2 L. of brown liquid. A necrotic slough was removed from the base of the cyst (Fig. 9).

By all appearances we were dealing with a disintegrated part of the pancreatic tail. The incised edges of the cystic wall were fixed with a series of silk sutures to the posterior ventricular wall. The anterior stomach wound was closed in two layers. After evacuating the left-sided cyst, we found that it had no connection with the right one. The duodenum, firmly adherent to this cyst.

Fig. 6 *(left)*.—Same case as preceding, three months after operation. Fig. 7 *(center)*.—Case 3, double cyst of head and tail of pancreas before operation. Fig. 8 *(right)*.—Same case, 52 days after operation.

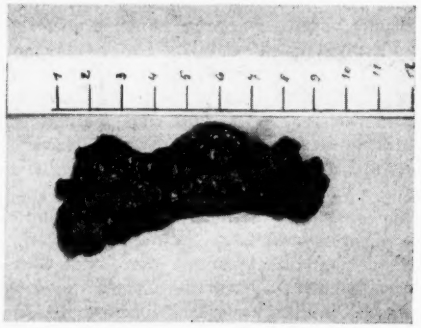

Fig. 9.—Same case as preceding, specimen removed at operation.

invited a repetition of the same operative procedure as on the stomach. But in order to carry this out, it was necessary to widen the wound in the abdominal wall through a transverse incision extending to the costal margin. Thereafter the anterior duodenal wall was opened above the highest point of the cyst, and a connection with the latter was then established with a cautery through the posterior duodenal wall. Through this opening 800 cc. of coffee-brown liquid were evacuated. The anastomosis was not sutured. The anterior duodenal wall was closed in three layers. The abdominal wall was then also closed in layers.

The postoperative course was satisfactory. The patient did not vomit nor have pain. He was fed with liquids in the same manner as the previous case. The wound was healed on the eighth day. The posture on the right side was again recommended. The patient was discharged 16 days after operation.

On Aug. 2, control examination showed the patient free of all complaints, eating normally. Only after large meals, and then infrequently, did he have a slight feeling of pressure in the stomach. He gained 24 lb. Abdominal findings were normal. Fasting blood sugar was 81 mg. per cent. There was hyperacidity of the gastric juice after 0.5 histamin in 60 minutes, free acid 100, total acid 120. Roentgen examination showed the stomach to be hook-shaped, somewhat shortened, of normal tone. The mucosal pattern was coarser. The barium outlines were smooth, peristalsis proceeded in fairly deep waves correctly to the pylorus, which is patent. The bulb lay horizontally and continued into the descending duodenal portion without formation of a subhepatic flexure. The duodenum was enlarged and still somewhat horseshoe-shaped. The middle part of the descending portion was slightly narrower, the mucosal folds were indistinct, and there was some stagnation in the bulb.

Thus, following operation, there were only slight retractive changes in the stomach and the middle part of the descending portion of the duodenum. The persisting widening of the duodenal curve suggests that a part of one cyst may still exist. But there was no penetration of the contrast meal into it.

Judging by clinical examination we could presume that both cysts are healed. The larger one left not even x-ray evidence. The smaller one, however, situated in the head of the pancreas, although no longer palpable, nevertheless left roentgen evidence of some duodenal deformity.

In our patients we were dealing with pseudocysts adhering to the adjacent alimentary tract. In the first two cases we performed a transstomachal pancreatocystogastrostomy after Jurasz. In the third patient we anastomosed one cyst with the stomach by Jurasz' method, the other one transduodenally with the duodenum after Kerschner.

The technic and operative procedure were sufficiently described under the heading of operative findings. I shall therefore limit myself to a few observations. The transstomachal and transduodenal routes for anastomosis in cysts adhering to the neighboring tissues have one great advantage, namely, that there is no suture to be endangered by the cystic contents. Sometimes no suture at all is required for anastomosis, and division by cautery only is necessary. The suture serves only hemostatic purposes. Therefore, it is just these pseudocysts which lend themselves best for Jurasz' operation, because they are characterized by the absence of epithelial lining and the wall is formed merely of peritoneal adhesions and organized fibrin. Of course true cysts also are frequently enveloped in adhesions.

I must emphasize the importance of a sufficiently wide anastomosis, particularly in pseudocysts, lest the anastomosis closes earlier by cicatricial retraction than the cyst itself. This premature closure of anastomosis took place in Neuffer's case, with a resulting reformation of the cyst and eventual perforation and death. Neuffer also points out Kerschner's first case: His patient died seven weeks after operation of pulmonary tuberculosis, and at autopsy it was found that the cyst, originally the size of a child's head, had shrunk to the size of a walnut since operation, while the anastomosis had contracted from 3 to 1 cm. Of course, obliteration may occur also in a pancreatic fistula. In our third case with the double cyst, I have the impression that the anastomosis with the duodenum was not wide enough. Of course, there is no absolute certainty that the cyst persists. The horseshoe shape of the duodenum may easily be caused by extensive adhesions. Not even the fact that we found no connection between the gut and the cyst, is sufficient proof of closure of the anastomosis. In the other two patients, we found no connection either on control x-rays, and yet we can hardly presume that

the anastomosis would have completely obliterated in so short a time. Experiences of other authors confirm our observations in this respect. It is therefore doubtful whether in our case the cyst persists because of premature closure of too narrow an anastomosis, or whether it persists with a persisting anastomosis not seen on the x-rays, or whether there only exists a permanent deformity caused by adhesions. Only further controls may throw some light on these questions.*

Anastomoses of the stomach with a jejunal loop in primary anastomoses of pancreatic cysts, to prevent reflux of gastric juice, appear to be unnecessary operations. Our experiences are also confirmed by other authors (Kerschner). The simplest method is the best (Rössing).

In choosing the site of anastomosis we only have to consider anatomic relations. The opening of the cyst into the duodenum might appear the more physiologic procedure, but our experiences as well as those of others concur in that it is on the whole immaterial, whether the cyst is opened into the stomach or into the duodenum. No major disturbances were ever noticed. From a technical viewpoint, I should give preference to stomach anastomosis, if anatomic conditions permit. The dimensions of this organ permit the formation of a sufficiently wide anastomosis; 3–5 cm. are to be aimed at. If we are forced to open the cyst into the duodenum, I recommend an anastomosis covering the whole width of the posterior duodenal wall.

Why have Jurasz's and Kerschner's operations not yet attained the popularity which they deserve, with most surgeons? The principal reasons for this are theoretical assumptions rather than true failures. After these operations only Ombrédanne's, Kafka's and Kerschner's patients died. In the first two it remains doubtful whether death was really in direct connection with the operation. The third one died of pulmonary tuberculosis. In all other recorded cases only the best results are known. One of the main objections to primary anastomosis is the danger of penetration of the contents of the alimentary canal into the cystic cavity. I cannot deny that we too shared this fear, even after our first, perfectly healed case. For one generally presumes that the gastric, duodenal or cholecystic contents might infect the pancreatic ducts and activate the pancreatic juice. Acute pancreatic necrosis is nowadays most frequently explained in this manner. Consequently anastomoses of pancreatic cysts with the alimentary canal would provide ideal conditions for such new lesions. Nevertheless these fears were not confirmed in a single case hitherto published. If reflux really takes place, it cannot, according to Vecchi, cause any damage of the character of pancreatic necrosis within the pseudocyst because of the latter's anatomic properties. In his opinion, pseudocysts are not in connection with any of the major pancreatic ducts, although the contrary is generally believed to be the case. Their growth depends directly on the absence of such a communication, while at the same time they are connected with a part of the secreting epithelium. The variation in size of the cyst in our first patient, and the temporary disappearance of the cyst in the second case, do not confirm this theory, but rather suggest that sometimes evacuation into the large pancreatic ducts is possible. On the basis of this theory, Vecchi explains why a possible reflux leads to no complications. The contents would come into contact only with the cystic wall and with a small portion of separated parenchym. The anastomosis would facilitate drainage of the toxic material. He even presumes that necrosis of any separated parenchymatous tissue, possibly caused by reflux, would facilitate healing of the cyst. But primary anastomosis gives equally good results in true pancreatic cysts, and it is therefore doubtful whether any reflux really takes place. None was ever proved radiologically; no definite signs of infection of new pancreatic necrosis were ever noticed. For the consideration of this question, Bedrna's experience with pancreatolithiasis is of interest. In 1942 Bedrna connected a hydropancreatic sac, which arose from an obstruction by stones, to the duodenum. Here the theoretical

* Since this was written, we examined the last patient again. On a stomach x-ray it was found that the widening of the duodenal curve has diminished, and the descending portion retracts toward the pancreatic head. The radiologist is of the opinion that this is without a doubt merely a duodenal deformity caused by adhesions. This is also confirmed by the absolutely negative clinical findings as well as by the perfect subjective condition of the patient. Consequently we regard this case of a double cyst also as healed.

presumption of penetration of the duodenal contents into the greater pancreatic ducts is more than probable, and yet no noticeable harm was done; on the contrary, the patient is symptomfree for more than 1½ years. Rössing believes that intra-abdominal pressure and flow of pancreatic secretion prevent reflux. Our observations show that no reflux of gastric contents into the cyst takes place, since none of our patients developed either pain, pyrexia or vomiting after the operation. Such symptoms were observed only by Jurasz on his patients, and he attributed them to retention of the cystic contents, because they disappeared in the prone posture. He was unable, however, to prove this supposition on roentgen examination. We advised our patients to lie on the side from the first postoperative day. We do not know whether this régime really prevented backflow or whether this did not occur for other reasons. The x-ray examinations of our first two cases suggest another explanation. We may judge by experiences from literature (Kerschner and Kafka), that within so short a time neither cyst nor anastomosis could have ceased to exist. In our first patient, signs of gastric impression at this time bore witness to that effect. In both patients there was a marked sensitiveness of the stomach wall at the site of the anastomosis, manifested by frequent spasms. In the second patient, this sensitiveness was so marked as to affect the whole antrum, which relaxed only with the passage of a particularly strong peristaltic wave. We presume that this spasm, caused perhaps by the cystic contents or by the operation itself, and increased during the passage of peristaltic waves, could prevent the penetration of gastric contents into the cyst. On the other hand, we believe that after a peristaltic wave has passed with the resulting evacuation of the contents through the pylorus or into the lower duodenal parts, a fall of pressure ensues at the site of anastomosis to a lower level than that within the cyst, with a consequent sucking effect on the cystic contents. We here imagine the same mechanism as in gastric aspiration.

It appears, therefore, that our fears regarding the influx and stagnation of the contents of the alimentary canal in the cyst, which formerly made us resort to two-stage operations, are exaggerated. Not even the dimensions of the cyst make any difference.

I shall attempt to dismiss another serious objection against anastomosis. Kafka, whose patient died on the ninth day after a Jurasz operation of hemorrhage from a broken vessel in the cystic wall, warns against primary anastomosis with the stomach, because he believes that digestion of the cystic wall may take place with resulting uncontrollable hemorrhage through gastric juice action. He rejects these operations particularly in pseudocysts, where thrombi in the eroded vessels exist in various stages of organization. He tried to prove these objections experimentally. He found that an acid medium or gastric juice prolongs blood coagulation time and prevents coagulation altogether at a concentration of pH 5. Although duodenal juice and trypsin cause immediate clotting, the clot is not normally adherent and is easily digested. In a mixture of gastric and duodenal juices trypsin is preponderant, and the sum total of the contrary influences is immediate coagulation of blood, while its digestion is faster and more marked. This objection might certainly be important, but Kafka's case appears to be the only one in the literature. Not even he mentions any actual case of an anastomosis with this complication, and he only cites authors who warn against hemorrhage from pancreatic cysts in general. It is, therefore, not impossible that Kafka's patient would have bled just the same after mere marsupialization, simply because of the character of the pseudocystic tissue itself. Thus there is no justification for the statement that hemorrhage is most likely to occur after anastomosis. In our patients we had to do exclusively with pseudocysts of short standing. In the first, two months had elapsed since appearance of the first symptoms suggestive of necrosis or cyst formation; in the second, one month and in the third and fourth, three months. On operation necrotic portions were still found in all of them. Moreover, the anastomoses which we established were very large, 3–5 cm. wide, so that conditions for hemorrhage were suitable. Yet we never saw even the slightest sign of bleeding.

I believe that the described good results

justify us to adopt another attitude toward pancreatic cyst operations than was hitherto generally accepted in this country. We recommend primary anastomosis with alimentary canal of all pancreatic cysts or pseudocysts of all sizes and without regard to their duration. When sufficient adhesions to the stomach or duodenum exist, the transstomachal or transduodenal route is the best. This is to be preferred to marsupialization. Total extirpation must always be attempted in cystic tumors of the pancreas. In other cysts this operation should be employed only in those cases, where anatomic relations guarantee its simple and easy performance. In these cases Jedlička's operation could be considered if conditions are suitable. Marsupialization of pancreatic cysts should, because of its unpleasant postoperative course and because of the danger of permanent fistula formation, join the ranks of operations of the past.

SUMMARY

I have reported our experiences with treatment of pancreatic cysts by its direct anastomosis to the stomach or duodenum. We have operated, within one year, on three patients with pseudocysts of the pancreas, with extensive adhesions with the adjacent tissues. In one of these a rare existence of two pseudocysts was found, which were not interconnected. One was situated in the head, the other one in the tail of the pancreas. The largest cyst had a content of 3 L., the smallest one of 75 cc. In the first two patients, a transstomachal operation after Jurasz was performed, in the third one, one cyst was connected to the stomach after Jurasz and the other one transduodenally to the duodenum after Kerschner. The results of all operations may be qualified as very good.

Jurasz' and Kerschner's operation is in fact a new realization of the old idea of Ombrédanne and Jedlička—namely, primarily to avoid pancreatic fistula formation. Experiences with this operation, although few, are sufficient to show that primary anastomoses are not only justified but that they possess many advantages. Most surgeons still neglect this operation, mostly for theoretical reasons, particularly for fear of a reflux of the gastrointestinal contents into the pancreatic cysts and ducts with resulting infection, pancreatic necrosis and, in pseudocysts, dangerous hemorrhage. Our experience, together with the good results obtained by other authors, do not confirm these objections. On the contrary, radiologic examinations carried out early after the operation lead us to believe that after primary anastomosis reflux is inhibited by a spasm at the site of the anastomosis, and that through peristalsis of the alimentary tract a sucking effect is exerted on the contents of the cyst, which consequently contracts rapidly. For this same reason we do not believe that hemorrhage is to be greatly feared. We did not notice bleeding, although all the pseudocysts were fresh, with large necroses. On comparing the surgeons' task, the postoperative course and the results in our patients with those operated on by another method, we arrived at the conclusion that primary anastomosis represents an important progress in the surgical treatment of the pancreatic cysts. We have rejected marsupialization and the two-stage operation. We recommend primary anastomosis with the stomach or duodenum in all pancreatic cysts and pseudocysts as the operation of choice. Extirpation is reserved for cystic tumors only, or for such cysts which promise a technically easy performance. In these cases, under favorable circumstances, Jedlička's operation may also be considered.

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Diaphragmatic Hernia

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THIS is a report of nine cases of diaphragmatic hernia found in the fluoroscopic and roentgenographic study of 411 cases of individuals with abdominal complaints in the course of the private practice of my wife, Dr. Laura Fisher, and myself during the past six and one half years.

Its purpose is to emphasize that [5, 7] diaphragmatic hernia is much more common than generally believed; [2] that it may be entirely symptomless; [3] that it usually manifests itself in terms of gastro-intestinal disease; [4] that it may manifest itself exclusively as symptoms referred to the cardiorespiratory system, and that [5] it should always be kept in mind when all the usual lesions of the upper abdomen have been excluded or symptoms persist in spite of adequate therepy for other lesions.

It should be emphasized that diaphragmatic hernias are often quite small, are easily missed on x-ray examination even when this is performed by experts, unless possible existence of the lesion is always kept in mind.

In this series the shortened esophagus with intrathoracic stomach in whole or in part was not found at all. The lesions all consisted of a herniation of a small portion of the cardiac end of the stomach through the para-esophageal hiatus. No hernias of the right diaphragm were found. The lesions were not manifested at all nor even suspected in vertical fluoroscopy except in one case, until the patient was placed in the prone and right oblique, prone horizontal and Trendelenburg positions on the fluoroscopy table.

None of the cases had been studied by x-ray previously, except one case who had been x-rayed twice during the previous four years by expert roentgenologists. Both roentgenologists had missed the diagnosis. One of these latter confirmed the diagnosis in a subsequent study by x-ray, after existence of the lesion had been pointed out to him.

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Our nine cases revealed the following data:

Age: The oldest was 61 years and the youngest 45 years. Most were in their fifties. Average age was 52 years.

Sex: All were females except one.

Etiology: The etiology of this condition is congenital,[2] although pregnancy, chronic cough, heavy lifting and straining, coupled with obesity are contributory factors.[3]

SYMPTOMS DIRECTLY REFERRING TO THE HERNIA

Six of the nine patients complained of pain in the left upper quadrant of the abdomen, substernally, deep in the esophagus, or of pain referred to the left shoulder, left neck or nape of neck. Seven suffered with postprandial pyrosis, sour eructations, gas, bloating, abdominal distention, etc. In some, the sour eructations became worse later in the day after successive meals, and in one the pyrosis was worse in the morning after breakfast and improved later in the day.

In some, the symptoms were worst at night, some could not lie down at all after a meal. In one patient liquid would roll right out of the nostrils to "choke" her; she could sleep only in a sitting position, propped up on pillows like a cardiac patient suffering with orthopnea.

One patient had hematemesis.[8] One patient had absolutely no symptoms at all with reference to her gastro-intestinal tract. Two patients had symptoms which pointed definitely to the gallbladder, and one had symptoms pointing to the appendix. Another was diagnosed by x-ray as having a duodenal ulcer. One patient had a moderate hydronephrosis and another a diverticulosis of the descending colon. Most patients were constipated. One had chronic diarrhea. One patient had symptoms of angina pectoris, and another had attacks of nocturnal paroxysmal tachycardia and premature ventricular beats. One patient had migraine and vasomotor rhinitis.

PHYSICAL FINDINGS

Physical examination in these cases was not helpful for diagnosis of diaphragmatic hernia. None of our patients had intrathoracic stomachs, and thus symptoms like borborygmi, peristaltic movements, tympany, etc., were not found in the chest. Obesity and over-weight condition were found in six of the nine. The others were of normal weight.

X-RAY EXAMINATION

In only one case was there an intimation of the existence of a diaphragmatic hernia during the course of fluoroscopic examination of the stomach in the vertical position. All cases were diagnosed while the patient lay in the prone, and prone right, oblique horizontal or Trendelenburg positions. Radiography and especially spot films confirmed the diagnosis.

Esophagoscopy, while valuable in the diagnosis of this condition, was not necessary in any case.

LABORATORY STUDIES

Three patients suffered with gastric hyperacidity in both free hydrochloric acid and total acids. Three patients had normal values for acidity, and in the other three no studies were made.

DIFFERENTIAL DIAGNOSIS

Diaphragmatic hernia must be differentiated first [9] from other gastro-intestinal diseases which it may simulate most closely and in the following order: gallbladder disease; peptic ulcer with hyperacidity; carcinoma of the cardiac end of the stomach; esophageal carcinoma; cardiospasm; diverticulum of the esophagus; appendicitis; diverticulum of the colon, etc.; secondly it must be differentiated from coronary disease [4, 10] like angina pectoris and coronary thrombosis with hypertension. Thus, four patients had hypertension and coronary sclerosis as proved by their clinical course and electrocardiographic tracings.

TREATMENT

Three cases needed no direct treatment of the hernia at all, because the patients had other gastro-intestinal lesions which adequately or eminently accounted for all of their symptoms and signs.

A conservative course of treatment on a medical regimen is always indicated, and it is surprising how much mitigation and amelioration of symptoms may be obtained by judicious use of a so-called bland diet, with pureed vegetables and stewed fruits, and one of the vegetable mucilages to combat constipation like siblin, alkalies like aluminum hydroxide and allied preparations like phosphogel, to control hyperacidity, and antispastics like trasentin with a sedative like phenobarbital, three or four times daily.

Recent advocacy and use of phrenico-exeresis [11] may produce gratifying results as in one of our cases.

Phrenico-exeresis is of value not only in the congenitally short esophagus with intrathoracic stomach, but also in the true paraesophageal hernia. Thereby, temporary or permanent interruption of the left phrenic nerve causes a paralysis of the diaphragm, allowing it to rise and permit the stomach to resume its normal position inside the abdominal cavity.

Finally, if all these methods fail, resort may always be made to closure of the diaphragmatic defect as described by Harrington.[6, 1] Surgical procedures were offered to our other five patients, but were refused or deferred for the present.

SUMMARY

1. Diaphragmatic hernia is a fairly common gastro-intestinal lesion.

2. Diaphragmatic hernia is a great simulator and may easily be mistaken for gallbladder disease, peptic ulcer and even coronary disease.

3. Diaphragmatic hernia may be quite small and thus easily and often overlooked and missed in the course of routine roentgenologic examination, even by experts.

4. Conservative medical treatment may greatly relieve the symptoms.

5. Phrenico-exeresis may give gratifying results, especially in the smaller lesions.

6. Operative repair may have to be used for the more intractable cases.

SOMMAIRE

1. La hernie diaphragmatique n'est pas rare.

2. Il est facile de la confondre avec les lésions de la vésicule biliaire, avec l'ulcere peptique, et même avec les troubles de la coronaire.

3. La hernie diaphragmatique est souvent d'un si petit volume qu'elle peut passer inaperçu dans le cours d'un examen roentgénologique. Elle est souvent méconnue même par les experts.

4. Un traitément médical approprié est souvent suivi de grand soulagement des symptomes.

5. L'exérèse-phrénique donne souvent des résultats bienfaisants, surtout dans les hernies de petit volume.

6. Dans les cas graves, on aura secours ou traitement opératoire.

SOMMARIO

1. L' ernia diaframmitica e molto comune lesione gastro-intestinale.

2. L' ernia diaframmatica e un grande simulatore che forse facile sara sbagliata per malattia alla viscica, ulcere peptiche e sin anco malattia coronaria.

3. L' ernia diaframmatica forse sara tanto piccol o che facilmente e spesso svista e sbagliata nel corso di rutinio di roentgenologica esaminazione pure da esperti.

4. Conservativo trattamento medico forse grandamente sollieva i sintomi.

5. Esercizio frenico forse dara gratificati risultati specialmente in piccolo lesioni.

6. Riparazioni operative forse dovranno essere usata per i piu intrattabili casi.

SUMARIO

1. La hernia diafragmatica es relativamente comun y cuando existe puede producir manifestaciones gastro-intestinales faciles de confundir con las enfermedades de la vesicula biliar, la ulcera peptica y las angines cardiacas.

2. Las hernias diafragmaticas que son muy pequenas son muy dificiles de diagnosticar y frecuentemente eluden el diagnostico radiologico.

3. El traitamiento medico conservativo da resultados favorables, eliminando los sintomas en ciertos casos.

4. La exeresis del nervio frenico es de valor especialmente en las hernias pequenas.

5. En los casos intractables es necesario de reparar operatoriamente el defecto diafragmatico.

Свод

1. Диафрагмовая грыжа случается довольно часто.

2. Она является великим симулатором и может быть легко ошибочно диагностирована как болезнь желчного пузыря, язва желудка или даже венечная болезнь.

3. Она может быть очень малой и даже эксперты могут ее легко незаметить при рентгенографии.

4. Консервативное медицинское лечение может очень облегчить симптомы.

5. Френико-эксерез может дать удовлетворяющие результаты, особенно при малых грыжах.

6. Оперативная починка может быть применена в более упрямых случаях.

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The Present Status of Pancreaticoduodenectomy for Carcinoma of the Ampulla of Vater and of the Head of the Pancreas

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SINCE its introduction by Whipple and associates [1] in 1935, and the development of the technic, first by Brunschwig [2] and later by Child,[3] Zinninger,[4] Orr,[5] Pearse,[6] Hunt,[7] Dennis,[8] Cattell.[9] Waugh,[10] Varco,[11] Cole and Reynolds [13] and many others, the operation for the radical removal of carcinoma of the ampulla of Vater and of the head of the pancreas has become established as an accepted surgical procedure. The use of the one-stage operation has become universal, because the development of adhesions after a preliminary procedure has made the second stage of a two-step procedure very difficult to execute and sometimes more difficult than the whole one-stage procedure. Only in cases of suppurative cholangitis, or in cases where gastric or duodenal obstruction has made the patient such a poor risk that he would not tolerate the single procedure, is the older two-stage operation performed, and then it is usually not done as originally conceived. The as yet unsettled technical details which concern this operation have to do with the decision as to the proper method of reestablishment of the gastro-intestinal continuity after the removal of the tumor-bearing region.

After a radical pancreaticoduodenectomy, the gastro-intestinal tract has been interrupted from the level of the pylorus (or more proximally) to at least the level of the ligament of Treitz. The distal half of the common bile duct has been removed as has the proximal half or third of the pancreas. The problem which faces the surgeon is not only the reestablishment of the continuity of the gastro-intestinal tract itself, but also that of the implantation of the common bile duct and of the pancreatic duct into the intestinal tract. From the theoretical point, the proper establishment of continuity would result in an execution of a gastro-enterostomy between the ends of the stomach and the jejunum, below which point the bile and the pancreatic secretions would be given access to the gastro-intestinal tract. In this way the bile and pancreatic secretion would contact the food just after it left the stomach. Because it is impossible to recreate the ampulla of Vater, and because of the danger of a leak at all anastomotic lines, particularly between gastro-intestinal tract and other structures (common bile duct, pancreatic duct), it has been necessary to modify this simpler plan of reconstruction. There are many problems which influence the choice of procedure at each step, and these are matters of such importance that they must be discussed individually. At the present time there is no uniformly accepted technic for this reestablishment of continuity.

Before this discussion of the problems is made, it should be pointed out that the following premises as to the operation seem to be well established and generally accepted: The resection should be as radical as is necessary to cure the patient of the malignant disease. The mortality must be kept at a low figure. The operation requires so much time, that attempts to simplify the procedure are being made to shorten the time. Fatality usually results when a leak occurs. This is most likely to occur at the site of the bile duct or pancreatic duct implantation.

REESTABLISHMENT OF GASTRO-INTESTINAL CONTINUITY

In early attempts at pancreaticoduodenectomy, a gastro-enterostomy was done as a preliminary operation, which also included a

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cholecystenterostomy. At a second operation, after the resection of the diseased tissue, the end of the stomach was simply closed. Although the abandonment of the two-stage operation did not at once lead to the dropping of this elaborate ritual, it was soon realized that the resection of the intestinal tract might well be carried up onto the stomach with minimal effort. The resection carried far enough proximally would give a gastric segment which could be utilized, as it is in gastrectomy according to the Polya technic, to anastomose into the side of the jejunum. This modification has been adopted in principle by all. The resection need not proceed further up the stomach than is required to secure a stoma which mechanically would empty well. The adoption of this step in the procedure, while requiring a little more time in order to resect the portion of the prepyloric portion of the stomach, has replaced the two anastomotic lines in the gastro-intestinal tract with the one line of the resection anastomosis. It has also helped shorten the operating time by avoiding the necessity of opening and closing the stomach.

The choice of a level on the jejunum at which to perform this anastomosis has also been a point of some indecision. The array of the methods already used does attest to the lack of a predetermined plan of restoring the desired and needed continuity. These varied methods represent solutions which seemed expedient to the surgeon after a long and rather unfamiliar operation. Although normal arrangements are admittedly preferable, the lack of a sphincter of Oddi, leading as it does to the risk of ascending infection from the passing food stream, has led to universal belief that the food stream should enter the intestine distal to the point at which the bile and the pancreatic ducts enter it. In other words, food must enter the jejunum far enough down the course of the bowel to avoid the danger of particles of food stuff entering and obstructing these ducts. This in the past was done by many technics. Whipple, and Dennis and Varco recommend insertion of the bile duct into the open end of the jejunum, which was brought up to the duct after having been freed from the superior mesenteric vessels and from its attachments at the ligament of Treitz. The pancreas may then be anastomosed to the side of the jejunum. Child, Waugh and Clagett utilized a loop of jejunum which they sutured about the open end of the pancreas. The common duct was sutured to this loop and then the stomach was anastomosed to it lower down. The handling of the bile duct in the Child operation resembles in principle that recommended by Cole and Reynolds, who after closing the distal duodenum brought the proximal jejunum first to the common duct before further implantations were made. In principle, these authors also early in their experience recognized the danger of food reflux by constructing a Roux Y, which was utilized to receive the bile before it joined the food in the gastro-intestinal tract distal to it.

In summary, the gastro-intestinal anastomosis should be made in the jejunum distal to the openings made for the common duct and for the pancreatic duct. It should be made from the open end of the stomach, since this procedure has been proven to be dependable, and in order both to eliminate one suture and to reduce the time of operation.

IMPLANTATION OF DUCTS INTO THE GASTRO-INTESTINAL TRACT

1. Common Duct Implanation.—In the two-stage operations, it was recommended that at the first operation the biliary tract be sidetracked by establishment of a cholecystenterostomy. This technic, in which a loop of jejunum was used (sometimes a Roux Y), was accompanied by a concomitant ligation and section of the common bile duct proximal to the pancreatic head, but distal to the entrance of the cystic duct. While this procedure seemed acceptable as long as the two-stage operation was in vogue, there were many obvious disadvantages. In the first place, the fact that occasionally the cystic duct entered the common duct within the substance of the pancreas, made it a treacherous, undependable technic. Furthermore, it is a matter of common knowledge that even in the face of complete common bile duct obstruction, cholecystenterostomy, when performed between the gallbladder and a loop of jeju-

num, is almost always followed by a spontaneous closure of the stoma within several months. Although the reason for this spontaneous closure of the stoma is not understood, its occurrence has been widely recognized and has led surgeons to utilize a defunctionalized Roux Y, into which the gallbladder may be anastomosed. This danger of spontaneous closure of the stoma led to the recommendation of Whipple that the jejunum be freed up and brought to the gallbladder. It also led Cole and Reynolds and others to utilize the Roux Y.

Much more serious was the objection which was brought to light by the autopsy findings of cases in which the one-stage operation had included the cholecystenterostomy, section of the common duct, section of the pancreas and final gastro-enterostomy. These patients were found to have developed an abscess deep in the abdomen, into which both the pancreatic stump and the open common duct drained. This abscess apparently developed when the bile in the cut end of the common duct activated the small amount of pancreatic juice which escaped from the cut end of the pancreas. The subsequent ascending suppurative cholangitis, liver abscesses and subphrenic abscesses which were found, pointed clearly to the technical unsoundness of allowing the open end of the common duct and the open end of the pancreas to lie near each other. These patients followed a disheartening postoperative clinical course. They lived several weeks only. At first they recovered fairly well, following which there was some evidence of a low grade peritonitis, limited usually to the region of the operation. Within five to seven days, a fairly profuse drainage from the wound indicated that the trapped secretion might now escape, and recovery was hoped for. Although this may have happened in some cases, usually this period was followed by the development of low grade jaundice, in the face of adequate amounts of bile in the stool, and soon by chills and fever. Subphrenic abscesses were occasionally diagnosed and drained, before death occurred.

These findings confirmed the soundness of the recommendation by many authors, that the common duct should be utilized as the tract for routing bile from the liver to the intestinal tract, no matter how attractive the more accessible gallbladder at first appeared. AT PRESENT THIS IS THE ACCEPTED TECHNIC.

This tendency for spontaneous closure of the cholecystenterostomy has been observed to occur also in anastomoses made between end of common duct and side of intestine. Its occurrence led Whipple, and Dennis and Varco, etc., to recommend that the operation be further modified by freeing the distal duodenum and proximal jejunum from beneath the superior mesenteric vessels, and using the freed open end of jejunum to which to anastomose the open common duct. Cole and Reynolds, Child and others chose in their technics to avoid the difficulty associated with freeing the jejunum from the superior mesenteric vessels and run the risk of the development of a stenosis. They recommended implantation of the common bile duct into the side of the jejunum. This recommendation was made particularly as a means of facilitating the technical execution of a very long and difficult operation, with the idea of reducing the operative time and thereby the mortality. Such an aim is important still, but it should be pointed out that one of the cases reported by Cole and Reynolds developed stenosis of the stoma at the site of the choledochal implantation. This patient developed jaundice some 14 months after operation. She died from nutritional deficiency about two months later; autopsy revealed the reduced size of the stoma and presence of stones in the proximal dilated common duct.

In summary, it may be said that the gallbladder should not be used for a passage of bile from the liver to the gastro-intestinal tract; that the common bile duct should always be used. The question as to whether or not the bile duct should be implanted into the open end of the jejunum into the open end of a Roux Y, is not as yet settled. It seems that the latter procedure may be so fraught with the danger of late stenosis that it will have to be discarded, but final decision in this matter must await further evidence, as judged by the outcome of patients upon whom this technic has been used. Under any circumstances, it is unsafe to leave a ligated cut proximal common duct stump anywhere near

the similarly ligated stump of the proximal pancreas.

2. Implantation of the Pancreas into the Gastro-Intestinal Tract.—Perhaps no stage of the operation has caused so much discussion as has this step. In the early cases, the pancreatic enzymes were considered unnecessary to such an extent that they were excluded from the gastro-intestinal tract. Although perhaps in the original decision to do this there was some factor of uncertainty both as to how to handle the pancreas and how to complete successfully a very long operation, the supposition was made that the succus entericus could and would take over the digestive functions ordinarily supplied at least in part by the pancreatic juice. In these cases the main duct of the pancreas was ligated, and the open end of the pancreas was then oversewed. Drains were left down to the pancreatic stump. The success of several of the early cases, in which this disposition was made of the pancreas, gives evidence that at least sometimes it is possible to live in apparent health without pancreatic enzymes entering the intestinal tract.

The fact that this technic is not entirely satisfactory is shown by several observations. The development of intra-abdominal abscesses, as stated, where pancreatic secretion and bile, even in small amounts, were able to reach each other, points to one danger. This danger, in large degree, has been avoided by the changes in technic, as stated. The development and persistence of pancreatic fistulas have been repeatedly observed, and retention of pancreatic juices within the abdomen (when a drain became displaced or did not function properly), has led to fatalities.

In addition to these dangers, and in spite of the success of some of the early cases, it was inevitable that the restoration of the pancreatic juice to the intestinal tract should appeal not only to the theoretical but to the technical sense of the surgeons. The attempts to accomplish this have been done by several means, and have been followed by differing results, as will be discussed later. In general, either the pancreatic duct was separately given access to the bowel, or the entire open cut end of the pancreas was implanted into the gastro-intestinal tract.

Zinninger was the first to implant the pancreatic duct into the jejunum. The duct, implanted over a vitallium tube, was put into the side of the jejunum, following which the rest of the cut end of the pancreas, oversewed, was approximated to the side of the jejunum. These sutures acted as much to stabilize the fragile point of ductal contact as anything else. Some cases treated in a similar manner with a Blakemore or vitallium tube have recovered without any evidence of pancreatic drainage; others have developed a pancreatic drainage, which required several months to subside.

From a technical view, the use of the pancreatic ducts as means of providing drainage into the intestinal tract, while very attractive, is frequently exceedingly difficult. The fine duct, the fact that it is intimately attached to the parenchyma of the organ (thereby preventing it from being freed up and easily handled, as is the common duct), make it hard to handle. It seems unlikely that this technic can be utilized in cases where the pancreatic duct is not markedly dilated.

Reynolds and Pearse[14] have recently studied the autopsy findings in two cases, in which the pancreatic duct had been implanted for over a year. These patients had lived apparently normal lives for some time, had had adequate protein and fat digestion, as measured by fat and nitrogen balance studies, as well as by the microscopic study of the pancreas. In these cases study reveals the presence of normal pancreas—not the atrophied pancreas with isolated islets of Langerhans, as seen after exclusion by ligation of the duct. Such findings belie the fear of some workers, that inevitably ascending pancreatitis would result in destruction of the pancreas, as well as the concern lest flare-ups of pancreatitis might be hazardous to the patients. There seems little doubt that pancreas so implanted retains its ability to secrete digestive enzymes, and that the ducts attain satisfactory connection to the gastro-intestinal tract.

The implantation of the pancreas into the side of the jejunum has been modified by Child, who implanted the entire open end of the pancreas into the open end of the jejunum (which had been pulled up over the ampu-

tated head of the pancreas). Fistulas following the method in which the implantation is made into the side of the jejunum, have been troublesome and occasionally fatal. There is evidence that the implantation of the head of the pancreas into the open jejunal stump is a much safer procedure.

In summary, the feasibility of the anastomosis of the pancreatic duct to the jejunum has been proven by autopsy specimens and should not be discarded until a much better method is proven. It is unlikely that this technic can be used when the duct is not dilated. It is possible that the development of the technic using the open jejunal stump may supplant both.

It may also be stated that while some of the early cases (and some later ones) seem to have recovered and lived in good health with the digestive ferments of the pancreas permanently excluded from the gastro-intestinal tract, it is likely that it is best to implant the pancreas, if the risk of the procedure is not too great and if the technic used will be followed by a good functional result.

Frequent deaths have followed the suture of the stump of the pancreas, and fistulas have been troublesome—a fact which merely emphasizes the inadequacy of this method of disposition of the problem. It is probable then that implantation of either the duct or the pancreas itself is preferable. In general, the implantation of the entire open cut end of the pancreas into the open lumen of the jejunum seems to be the safest technic. The frequent deaths that have followed when the entire cut surface of the pancreas is implanted into the side of the jejunum occurred when the anastomosis leaked. It is imperative that any such step be executed with great care, and, if possible, this technic is one which should be abandoned. The implantation of the duct into the side of the jejunum successfully accomplished has been proven to give satisfactory results, as judged by pancreatic section as well as by digestive studies. Its technical difficulty make it always trying, and frequently either impossible or frankly unsafe. It seems less safe than the procedure of implantation of the entire pancreas into the open end of the jejunal lumen.

SUMMARY

Respecting alike the necessity of a cure for cancer, a proper reestablishment of intestinal continuity and the low mortality figure, it is likely that we must adopt the following tenets: the anastomosis between the stomach and the intestine must be distal to the entrance of both the bile duct and the pancreatic stump. The anastomosis between the bile duct and the intestine should utilize an open end of a jejunal segment. The dilated pancreatic duct should be over a prosthesis into the side of the jejunum. The pancreatic stump, when the duct is not dilated, should be buried into the open end of the proximal jejunum, which, as a defunctionalized loop, should be implanted into another blind loop of jejunum, constructed to receive the common bile duct. This loop distal to both stomas then receives the food from the stomach.

It is pointed out that all technics aim at the prevention of leaks at the weakest point of the operation, namely the point at which anastomosis is made between the gastro-intestinal tract and the pancreatic or the common bile duct.

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An Unusual Operative Approach in a Case of Left-Sided Retrosternal Diaphragmatic Hernia

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DIAPHRAGMATIC, nontraumatic hernias always receive considerable clinical interest because of their diagnostic and therapeutic aspects. This is fully justified. The diagnostic aspect is of interest as a source of frequent error, because the clinical signs and symptoms, lacking uniformity and similarity, vary considerably. In most cases neither the symptoms nor the physical signs permit the diagnosis of diaphragmatic hernia, or even a suspicion of it. Only the more recently developed roentgenologic methods provide the means by which this pathologic condition can be recognized, and by which its significance as a possible origin of the patient's symptoms can be assessed. Therapeutically, diaphragmatic hernia is of interest because its surgical repair imposes unusual requirements on the surgeon.

Historically, a nontraumatic congenital diaphragmatic hernia was, according to Bowen, first described by Riverius Lazarus in 1689; Morgagni described such hernias in 1769. Hedbloom writes that Bowditch, in 1854, was the first to recognize a diaphragmatic hernia in a living patient, and that Lichtenstein, in 1874, collected 345 cases from the world literature, principally as pathologic reports. Among them, the condition was recognized *intra vitam* in only two cases. More recently, there has been lack of differentiation between congenital and acquired diaphragmatic hernias or those caused by traumatic rupture of the diaphragm. To the surgeon, of course, it is more or less irrelevant to which group a hernia belongs, since surgical intervention remains invariably difficult. Not infrequently even eventration of the diaphragm has been classified as diaphragmatic hernia.

Within the last decade reports of diaphragmatic hernias have markedly increased in number. Since it is doubtful that the actual case incidence has increased, improved diagnostic methods must be the cause of this numerical increase in reported cases. This appears to be true from the Harrington report from Mayo Clinic. Not more than 30 cases of diaphragmatic hernia were observed in that clinic up to 1925; the number grew to 680 up to 1939. Harrington himself operated on 250 cases up to 1939. In 1931, Hedbloom collected 1,003 cases from the literature, with some additional cases probably still uncollected. In view of these data our own report of a case may not be justified. However, it belongs to the much rarer type of diaphragmatic hernia. We found that true, nontraumatic diaphragmatic hernias developed most frequently in the trigone of Bochdalek, followed by those in Larrey's triangle.

A case collection by French surgeons in 1935 provides an approximate idea of the incidence of this type of hernias, which are also described in the literature as substernal, retroxiphoid, parasternal or subcostosternal. Of 300 cases, only 18 belonged to this type; 17 of these were right-sided and only 1 left-sided. Thus surgical experience with this group of hernias is obviously small, and since we used an apparently new operative approach, we consider a detailed report justified.

A man, 34, with irrelevant family history, had rheumatism at the age of five, and sciatica in the left leg two years before he was seen by us. His bowel movements were always difficult, irregular and constipated. Seven years ago he fell off a bus, on his back, but apparently, aside from temporary breathlessness and nausea, received no serious injuries. For the past two years he complained of a continuous pressure beneath the left costal margin, particularly when sitting. The

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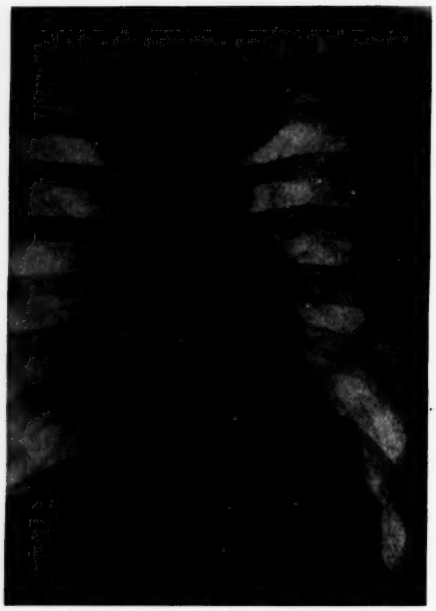

Fig. 1.—Roentgenogram of chest. Colon not filled with contrast medium. Note saeculations of colon, homogenous shadow outside of colic loop above diaphragm, undoubtedly belonging to part of omentum contained within hernia.

Fig. 2.—Contrast film, showing diaphragm and opaque meal in stomach. Stomach within normal distance of midline; transverse colon is to the right, partly within hernia. No splenic flexure.

sensation disappeared with change of posture. Pain was occasionally present. In June, 1942, he was given a roentgen examination, and Dr. Tvaroh suspected diaphragmatic hernia. During the following months the objective picture improved, but his symptoms remained unchanged. War conditions forced him to do mechanical work, not, however, involving physical exertion. His complaints increased steadily. Walking or the slightest jerk elicited pain at the left costal margin, so severe that he fainted several times. When lying down, the symptoms gradually disappeared. Eventually he could not tolerate riding on public transportation systems, and he was given another roentgen examination. Dr. Peyerl definitely diagnosed left-sided diaphragmatic hernia, a diagnosis confirmed by one of us. Weight loss since April, 1943, had been 31 lb. The pressure by now was constant, and considerable nervousness had appeared.

He was admitted on July 17, 1943. His nutritional status was poor and his musculature flabby. He was of the asthenic type of build. The chest, particularly in its distal portion, was markedly flattened, and both parasternal regions were slightly depressed below the level of the sternum. The abdomen was level with the chest, without par-

Fig. 3.—Lateral projection. Opaque meal in colon. Note diaphragm and gas filled portion of colon lying in front of heart above diaphragm.

ticular findings on palpation. Percussion of the lungs yielded no major abnormalities. A tympanitic note could occasionally be elicited in the left parasternal region, while at other times the normal cardiac dulness was absent at that place. At the back, the paravertebral percussion note was somewhat shortened up to the level of the scapular angle, with breath sounds muffled or altogether absent within the same area.

Roentgen Examination.—The vault of the diaphragm reached about to the level of the seventh costal cartilages on both sides. On the left, above the heart shadow, were several bubbleshaped translucencies, 2–2.5 cm. to the left and in front of the heart. These varied in size, number and relative position during the day. Lying between the fifth and seventh ribs, they were sharply separated on their left from the lung field by a light shadow running diagonally from the left contour of the heart shadow to the anterior costophrenic angle. The character of the translucencies corresponded to gas bubbles in the large intestines. The left diaphragm was normally mobile; Müller's test was negative, but as far as could be observed, the bubbles shrank to some extent during the test. Heart, esophagus, cardiac orifice, stomach, pylorus and duodenum appeared to be normal. The transverse colon filled within 24 hours, one part of it lying behind the chest wall above the diaphragm to the left of the midline (Fig. 3), and sharply curved. While standing, this colic flexure reached to about 9 cm. above the diaphragmatic vault and some 14 cm. above the ninth costal cartilage. The sacculations of this thoracic part of the colon were normal. The outer part of the shadow did not contain intestinal coil; it was, however, repeatedly visible on all films, even when irrigography (contrast enema) was used (Fig. 2). Irrigography did not reveal any narrowing of the gut at the level of the diaphragmatic attachment which would point to a constriction of the hernial orifice. We concluded from this examination that the hernial orifice measured at least 7.5, perhaps 9.5, cm. in diameter. The upper curve of the sigmoid appeared to the left and in front of the right ilium, the distal end of the descending colon to the right from the midline, and its proximal end in the left paravertebral line. The splenic flexure was absent.

We concluded that the left-sided congenital diaphragmatic hernia was located in Larrey's triangle, had a wide hernial orifice and that it contained part of the transverse colon; the hernial sac appeared to be outside the pleura in the anterior mediastinum. The congenital character of the hernia was indicated by the apparent looseness of the mesocolon. Since the hernial portion of the large intestine remained unchanged in position, adhesions were believed present. Operative findings on the whole confirmed the roentgen diagnosis. A wide hernial orifice was found, and the hernial sac contained not only a portion of the large intestine but also part of the omentum, both tied by adhesions. The lips of the opening were formed laterally by muscular fibers of the diaphragm and anteriorly by the rib.

This case was thus of special interest, not only because it was a hernia on the left side, where anatomic conditions are different than on the right, but also because the hernial sac was outside the pleura in the anterior mediastinum, a location not mentioned in any reports in the literature. We therefore reviewed our anatomical knowledge of this region, seeking the most suitable operative approach to the hernia and the orifice.

After careful consideration of all anatomic factors and study of the available literature, it seemed clear to us that best access to the sac was to be gained by direct opening of the anterior mediastinum from the left side. The operation was done under local anesthesia combined with light ether anesthesia because of restlessness. An incision was made from the left nipple towards the sternum,

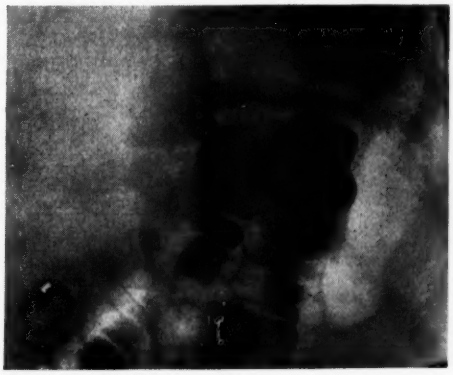

Fig. 4.—Contrast film 36 days after operation. Note left diaphragm and transverse colon below diaphragm, still to right of stomach which is filled with gas.

down along the left sternal margin and back along the seventh rib, forming a square flap with its base outside. This flap was reflected laterally. The costal cartilages of the fourth, fifth and later the sixth ribs were resected for about 8 cm. After cutting through the endothoracic fascia, the pleural fold was revealed and easily pushed outward without opening it. Immediately adjoining the pleural fold, between it and the pericardium, the hernial sac appeared, about 15 cm. long and containing

a considerably adherent transverse colon and part of the omentum. The sac was gradually isolated until the hernial orifice was reached. This was defined laterally by a fairly thick muscular bundle, medially by a thinner muscle, both of them converging backward—into the diaphragmatic vault—at an acute angle. Anteriorly the opening remained patent. The sac, of the thickness and character of an ordinary inguinal sac, was opened, the colon and omentum were separated and returned to the abdomen. Then the sac was tied at its base and amputated. The hernial orifice was closed by suturing the muscle fibers, which in their turn were sutured onto the muscles of the chest wall. The wound was closed by muscular and cutaneous suture, using mild positive pressure to obliterate the resulting cavity—the size of a fist—between the pleura and the pericardium.

Convalescence was at first disturbed by a subcutaneous hematoma, which, however, soon emptied itself. Subpyrexial temperatures persisted for fairly long, but they had existed before the operation. Thirty days after operation it was necessary to evacuate about 1,000 cc. of slightly hemorrhagic, bacteriologically sterile fluid from the left pleural cavity. Blood count at this time was 6,800 leukocytes. There were no cardiac or gastrointestinal complications. The patient states that the disagreeable pressure sensation in the cardiac region has disappeared, and he feels well. Roentgen examination 30 days after operation showed the colon in normal position.

The operation showed that the ordinary methods of approach, such as laparotomy or thoracotomy, would have been entirely inadequate.

SUMMARY

A rare case of a left-sided retrosternal diaphragmatic hernia is reported. Roentgen examination correctly pointed out the extrapleural position of the hernial sac, which contained part of the transverse colon and of the omentum. Operation was performed without technical difficulties through an anterior left-sided mediastinotomy. The authors believe that this is the only rational route for hernias of this type.

SOMMAIRE

Les auteurs rapportes un cas rare d'hernie diaphragmatique rétrosternale située à gauche. L'examen roentgénoscopique révéla la situation extra-pleurale du sac herniaire. Le sac renfermait une portion du colon transverse et l'épiploon. On opéra sans difficultes techniques par la voie antérieure médiastinale à gauche. Les auteurs exprimes l'opinion que c'est la seule voie rationnelle pour les hernies de cette catégorie.

SOMMARIO

Un raro caso al fianco sinistro di ernia diaframmatica retroesternale e rapportata. Una esaminazione Roentgen correttamente addita la estrapleurale posizione del sacco ernico in cui contiene in parte colon traverso e il epiploo. L' operazione fu eseguita senza difficolta tecnica quandunque una anteriore fianco sinistro mediastinotomi. Gli autori credono che questa e l' unica via razionale per ernia di questo tipo.

SUMARIO

El autor presenta un caso raro de hernia diafragmatica retro-esternal comprobada por la radiologia, la cual demostro el saco herniante conteniendo parte del colon transverso, y una porcion del epiplon mayor. El paciente fue operado por una mediastinotomia anterior del lado izquierdo.

Свод.

Доложен редкий случай ратростернальной диафрагматической грыжи. Рентгенография правильно показала экстраплевральное положение грыжевого мешка, содержащего часть поперечной ободочной кишки и жировик. Операция была произведена без никаких технических трудностей через переднюю левую медиастинотомию. Авторы считают это единственным рациональным подходом в грыжах этого типа.

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Pelvic Sympathectomy*

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ALTHOUGH sympathetic denervation of the pelvic organs has probably been attempted more often than any other type of sympathectomy, there is still more uncertainty about the indications and results than with the other types of surgical procedures on the sympathetic nervous system. As consequence of the technical accessibility of the superior hypogastric plexus (presacral nerve), its resection has been widely, if not adequately done by many surgeons, and often in conjunction with other surgical procedures in the pelvis. Thus the results have been difficult to assay and often disappointing. However, presacral neurectomy, properly performed in properly selected cases, is a surgical procedure with no more risk than simple laparotomy, with no significant sequelae and with gratifying results. The superior hypogastric plexus, the so-called presacral nerve, has been described by many authors, notably Weinstein,[1] who based his account on 150 dissections. The plexus arises from the intermesenteric nerves, which in turn arise from the renal or aorticorenal ganglion, from the periarterial plexus of the renal arteries, from the transverse aortic bar, from the first and second lumbar sympathetic ganglia and occasionally fibers from the first sacral ganglia. These fibers run posterior to the iliac vessels, and in operations for removal of the presacral nerve they must be looked for carefully. Weinstein states that he found these fibers to be arranged in a plexus pattern in 88 per cent of cases, in bilateral cords or trunks in 8 per cent and in a single nerve in 4 per cent. Labate,[2] who made a similar study based on 75 dissections, found a plexus arrangement in 84 per cent, double trunks in 8 per cent and a single trunk in 8 per cent. The predominating plexus arrangement typically consists of an intermediate cord and two lateral ones, but every possible variation of this basic arrangement exists.

This group of nerve fibers is found posterior to the peritoneum, lying anterior to the fifth lumbar vertebra and the upper part of the sacrum in the trigone bounded by the bifurcation of the iliac vessels. Inferiorly it bifurcates into two separate strands or trunks that pass laterally to the hypogastric ganglia lying on either side of the rectum. One of these may be larger than the other, but both are constant. These fibers of the superior hypogastric plexus lie in the layer of loose areolar connective tissue posterior to the peritoneum, but are superficial to the prelumbar and presacral fascia in which lie the middle sacral vessels.

Ever since Cotte[3] performed the first presacral neurectomy in 1925, this procedure has been used for two principal purposes: either to modify the motor activity of the bladder and rectum or to interrupt pain pathways from the bladder and the uterus. Learmonth presented clinical evidence that the presacral sympathetic fibers were inhibitory to the bladder detrusor muscle and motor to the muscle of the internal sphincter, and that stimulation of the presacral nerve would produce relaxation of the bladder wall with contraction of the internal sphincter. However, Young and Wesson[4] have shown that the so-called internal sphincter is really an ingenious arrangement of fibers of the detrusor muscle which, when relaxed, closes the bladder orifice and when contracted, pulls it open. The studies of one of us (HEL) and Frantz[5] on posterior trigonal hypertrophy verify this hypothesis. In this concept there is no need for a dual antagonistic innervation of internal sphincter muscle and detrusor muscle. Learmonth,[6, 7, 8] Langworthy,[9] McLellan[10] and others have reported favorable results following presacral neurectomy in various types of neurogenic (cord) bladders. How-

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ever, Learmonth [11] later stated that presacral neurectomy had been disappointing in cases of cord bladder. Since Thompson and Jacobson [12] have shown that transurethral resection of a portion of the internal sphincter is so helpful in many cases of neurogenic urinary retention, little attention has been paid to the use of presacral neurectomy. This is desirable, as the cumulative evidence fails to indicate that removal of the sympathetic innervation of the bladder will significantly affect either normal or abnormal micturition.

The use of presacral neurectomy for interruption of visceral pain impulses from the pelvis is in a different, although admittedly disputed territory. In the female this procedure has been used extensively for pelvic pain of various types. Numerous authors have reported their satisfactory results in primary dysmenorrhea. Marshall and Kennedy [13] and Carmaday [14] have reported the largest series of cases. The former authors reported excellent or good results in 92 per cent of 80 cases, the latter in 85 per cent of 21 cases of primary dysmenorrhea. Many gynecologists, including these authors, have performed presacral neurectomy in conjunction with other pelvic procedures in cases of secondary dysmenorrhea, i.e., of dysmenorrhea associated with pelvic abnormalities of some type. The value of the resection of the sympathetic nerves in such cases is difficult to assay, but the many favorable reports suggest that it is a valuable adjunct to the correction of pelvic lesions in these cases.

Presacral neurectomy in cases of pelvic pain due to carcinoma of the cervix or body of the uterus has, on the other hand, proved disappointing to most authors, although Behney [15] and Greenhill [16] have reported encouraging results in such cases. Obviously pain can be relieved only in structures whose afferent nerve supply passes through the superior hypogastric plexus. Uterine carcinoma early extends beyond the uterus with invasion of other pelvic organs and often the wall of the pelvis, with involvement of sensory somatic fibers of the lumbosacral nerve roots or plexus. Thus, it is obvious that excision of the superior hypogastric plexus cannot be expected to control the pain in such cases. On the other hand if the lesion is confined to the uterus, the pain may be relieved by this procedure. A recent case cared for by one of us (HCV) is instructive in this regard.

M. Z., 49 year old white woman, was admitted Apr. 20, 1947. One year before, vaginal bleeding had been noted. Six months later, pain in the left thigh began. She had had an abdominal exploration elsewhere, and since then had been receiving high voltage roentgen therapy.

Examination revealed a thin woman with drawn features, who complained of severe pain in the left hip, radiating down the posterior aspect of the left lower extremity to the ankle. Pelvic examination revealed a fixed ulcerated cervix with fixation of the uterus and marked tenderness, especially to the left. There were no reflex or sensory changes in the lower extremities.

The pain required frequent doses of morphine, and because of this she was transferred to the neurosurgical service, where a right unilateral anterolateral cordotomy at the level of the fifth thoracic vertebra was carried out on May 6, 1947. She made a good convalescence from this procedure. She had no weakness of the lower extremities, no diffiulty with sphincter control and had loss of sensation to pin prick on the left side below the ninth thoracic dermatome (midway between the umbilicus and costal margin). She no longer complained of pain in the left hip and lower extremity, but now complained of suprapubic and pelvic pain which still required opiates to control.

It was felt that this pain originated in the uterus and perhaps bladder, and to control it by cordotomy would require re-operation with a left cordotomy so as to give bilateral section of the spinothalamic tracts. Visceral afferent pathways in the cord are not well known, but it is probable that they are bilateral. It has been well established that visceral pain from unpaired abdominal structures cannot be relieved by unilateral cordotomy. On the other hand, it was felt that presacral neurectomy might now suffice to relieve her remaining pelvic pain.

The abdomen was reopened on June 2, 1947, through the former midline incision, below the umbilicus. The uterus was enlarged, firm, irregular, and the omentum and sigmoid colon were fixed to it. All of these structures were firmly fixed to the left lateral wall of the pelvis. The free margin of the liver was nodular and irregular. Resection of the superior hypogastric plexus was carried out and the wound closed.

Convalescence was again uneventful, the wound healing by primary intention. She now was able to discontinue the use of morphine and, after its withdrawal had been accomplished, was dismissed to the care of her family.

It is obvious that there were two peripheral pathways involved in this patient's pain. The one, the lumbosacral plexus and its roots, was interrupted centrally by section of the opposite lateral spinothalamic tract; the other, a visceral afferent path from the pelvic organs, was interrupted peripherally by resection of the superior hypogastric plexus. This latter alone would not, of course, have relieved the pain in the left lower extremity, but this case shows that the pelvic visceral pain afferents have a pathway through the superior hypogastric plexus.

The problem of relief of intractable bladder pain often presents itself to the urologist. The pain and frequency of interstitial cystitis (Hunner's ulcer), tuberculous cystitis and malignancy of the bladder are often so severe as to demand surgical interruption of pain pathways. To interrupt the pain pathways from the bladder by posterior rhizotomy of spinal nerve roots is not practicable, because of the extensive surgical exposure demanded. Anterolateral cordotomy, if bilateral and performed at the fourth to sixth thoracic segments, will relieve the pain but carries a risk of motor paralysis or loss of sphincter control, that can be justified only in cases of malignant disease where the only therapeutic hope is pain relief. These risks for the patient with a long life expectancy are usually unjustifiable.

The presence of visceral afferent pain fibers from the bladder in the presacral nerve has been denied by McLellan [10] and others. Learmonth [17] described a patient who complained of a sensation of "crushing pain in his bladder," when the central end of the presacral nerve was stimulated during resection of the nerve under spinal anesthesia. We [18] have verified this observation. One of us (HEL) has noted many times during cystoscopic examination of the bladder or during transurethral operations, that under spinal anesthesia with a sensory level between the costal margin and the umbilicus distension of the bladder was painful, although there was no pain on cutting or fulgurating the bladder wall. Both of us have noted [18] during cystometrograms on patients with transverse lesions of the spinal cord, that awareness of the bladder distension with discomfort was present, even in lesions as high as the sixth thoracic segment. Evidently sensations of stretch or distension of the bladder enter the spinal cord as high as the midthoracic segments and certainly above sacral levels (pelvic nerves).

Attempts at complete sensory denervation of the bladder by resection of the hypogastric ganglia have been made by Learmonth [19] and others for intractable bladder pain. This procedure results in paralysis of the bladder with a necessity for catheterization for the remainder of the patient's life. Resection of the superior hypogastric plexus, on the other hand, produces no disturbances of micturition and does interrupt important visceral pain pathways. In common with others, we have found that when dealing with chronic bladder lesions such as submucous and tuberculous cystitis, the effect is not lasting. We believe this to be due to regeneration of these visceral afferent fibers, which at best are seldom interrupted for more than 5 cm., with the central ends of the afferent fibers probably not more than 10 cm. from their termination in the bladder wall. Regeneration of visceral nerve fibers, both motor and sensory, is apparently readily accomplished; in this case, where only a relatively small segment of peripheral afferent fiber is removed, such regeneration may be expected to occur within a year or less.

The question may be asked as to why the resection of the superior hypogastric plexus has given such good results in dysmenorrhea and in other pelvic pain of uterine origin. Where this procedure has given relief in cases of uterine (or for that matter bladder) malignancy, the period of survival after the procedure is often less than the length of time that is probably required for regeneration. Even if the patient survives long enough for regeneration to take place, the malignant lesion has probably invaded the adjacent structures and the production of somatic pain not only clouds the return of visceral pain sensation, but also requires more radical measures (cordotomy) for relief. As far as primary or functional dysmenorrhea is concerned, the cause of the pain in this condition is not clear. It is possible that breaking the reflex sensory arc over a period of months is sufficient to affect permanent cure, even though regeneration of nerve fibers later takes place.

The following cases illustrate the prolonged but temporary relief obtained in chronic, painful inflammation of the bladder by presacral neurectomy.

G. D., a white man, 32 years old, was admitted on Oct. 23, 1936, with complaints of urinary frequency, dysuria, dribbling of urine and difficulty in starting the urinary stream, all of one year's duration. Fourteen months before his left kidney had been removed because of renal tuberculosis. He was voiding or attempting to void every 10–15 minutes through the day, and 10–12 times every night. Pain on urination was extremely severe. He had difficulty in starting his stream, and urination was largely a matter of painful dribbling. The urine was always cloudy. Cystoscopic examination revealed a hemorrhagic bladder mucosa with several ulcers on the posterior bladder wall. No tubercle bacilli were seen on repeated microscopic examination of the urine, but an intravenous pyelogram showed a moth-eaten appearance of the calices of the right kidney.

Presacral neurectomy was carried out on Oct. 31, 1936. The patient made a satisfactory convalescence with primary healing of the wound. When dismissed on Dec. 9, 1936, he was voiding three to four times nightly and about every hour during the day. Cystoscopic examination showed no change in the appearance of the bladder. A month later he had gained 15 lb. and was only voiding one to two times at night and every two hours during the day. However, he reported by letter in March, 1941, that he was voiding about 15 times through the day and 7–8 times at night, about an average of once an hour for the 24 hour period.

This patient's temporary marked alleviation of bladder pain was not permanent. Nevertheless, even five years later he was improved over his preoperative condition and had been spared an external ureteral transplant.

B. M., a 42 year old white man, was admitted July 23, 1937, because of urinary frequency and dysuria of six years' duration. He was voiding every 30 minutes through the day and every two hours at night. The right kidney had been removed soon after onset with no relief of symptoms. It had proved to be tuberculous on examination.

Cystoscopic examination revealed moderate congestion of the bladder mucosa which was studded with many superficial ulcerations. No tubercle bacilli were found in the urine with repeated microscopic examinations. An intravenous myelogram revealed an essentially normal left kidney.

Presacral neurectomy was carried out July 26, 1937, under spinal anesthesia, with the sensory level at the ninth thoracic segment (midway between the umbilicus and the costal margin). Electric stimulation with a 60 cycle current of the central end of the presacral plexus produced subjective sensation of a full bladder and a desire to void.

Convalescence was uneventful. When he was dismissed on Aug. 6, 1937, he had no bladder pain and only slight urethral pain on voiding. He was voiding every hour to an hour and a half during the day and every three to four hours at night. By Jan. 21, 1938, he was voiding every two hours during the day and once or twice at night, sometimes going as long as seven hours at night without voiding. However, six months later he returned saying that he had been improved until the past six or eight weeks, when his old symptoms had returned. He was now voiding every 20–30 minutes during the day and three to four times at night. This patient's relief was spectacular and lasted nearly a year. Then his symptoms rapidly returned to their old severity. In our opinion, regeneration of visceral pain fibers removed at the presacral neurectomy explains this return of symptoms.

The surgical technic of presacral neurectomy has been described by numerous authors, and the surgical approach hardly needs repetition. Thoroughness of dissection cannot however be overemphasized. The fact that we are removing a plexus of fibers rather than a single nerve and that this plexus presents many individual variations, makes careful dissection of the area between the iliac vessels necessary. Fibers from the sympathetic chain reach this plexus from beneath the iliac vessels as well as above them, and they must be found.

We have attempted to explain some of the failures of this procedure on physiologic or anatomic grounds, but we are convinced that many failures represent an inadequate operative procedure. The approach is one that is familiar to every surgeon and gynecologist; unfortunately, not every surgeon or gynecologist has the patience or skill tediously to dissect out a plexus of fine nerve fibers deeply located in an operative field such as this. Unless the operator has or will acquire this patience and skill, he should not attempt the procedure because, as in other types of sympathectomy, completeness of extirpation is essential to success.

SUMMARY

Resection of the superior hypogastric plexus is one of the simplest of sympathectomies. It has no effect on the normal reproductive organs of the female, but may produce loss of ejaculation in the male without interference with libido or potentia.

It has little or no value in disturbances of micturition, but since it carries visceral afferent pain fibers from the bladder and uterus, its resection is of value in painful conditions limited to these two organs. However, in chronic lesions results lasting beyond 12–15 months cannot be predicted, probably because of regeneration of visceral afferent fibers. Further anatomic studies on this point are desirable.

SOMMAIRE

La résection du plexus hypogastrique supérieur est une des sympathectomies les moins difficiles. Cette opération n'a aucune influence sur les organes génitaux de la femme; chez l'homme elle peut entraîner la perte de l'éjaculation sans diminuer aucunement le désir sexuel ou la puissance génésique.

Elle a peu ou pas de valeur dans les troubles de micturition. Comme ce plexus transmet des fibres sensitifs à la vessie urinaire et à l'utérus, sa resection a de la valeur dans les troubles douloureux limités à ces deux organes. On ne peut pas assurer aux malades que le soulagement obtenu sera permanent au-delà de 12 à 15 mois. La récidive des troubles est probablement due à la régénération des fibres viscerales afférantes. Le sujet demande d'autres études intéressant l'anatomie de cette région.

SUMARIO

La resección del plexo hipogastrico superior es un procedimiento relativamente facil de ejecutar y no afecta en modo alguno la función de los organos de la reproducción en la mujer, pero puede producir la perdida de la eyaculación en el hombre sin afectar su potencia o libido.

La porción superior del plexo hipogastrico contiene las fibras nerviosas que transmiten las sensaciones dolorosas del utero y de la vejiga urinaria; por lo tanto su resección es de valor en las afecciones cronicas dolorosas de dichos organos, sin embargo no se puede predecir los resultados beneficiosos de esta operación por mas de 12 a 15 meses por la posibilidad de que dichas fibras regeneren.

Свод

Резекция plexus hypogastricus superiorius является одной из самых простых симпатэктомий. Она не имеет влияния на нормальность женских репродуктивных органов, но у мужчин может причинить потерю эякулации, но без потери libido и potentia.

Резекция совершенно бесполезна при расстройствах мочеиспускания, но так как plexus содержит висцеральные афферентные болевые волокна от мочевого пузыря и матки, то его резекция полезна при болезненных условиях этих двух органов. Но при хронических поражениях нельзя предсказать результаты после 12-15 месяцев благодаря регенерации. Желательны дальнейшие исследования.

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Congenital Lung Cysts

Pathologic Characteristics and Importance of Recognition*

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MUCH progress has been made in the surgical management of various inflammatory and neoplastic conditions of the chest. When the diagnosis is clear, a high percentage of satisfactory results may be expected in most cases.

Until recently, a congenital condition of the lung commonly called cystic disease or cystic malformation was not well understood and was thought to be a rather uncommon lesion. This was due to the fact that in many instances it was mistaken for a number of other pathologic conditions and was, therefore, not recognized, until resection of the lung became commonplace and the lesion was found in the surgical specimen. In spite of the recognition of pitfalls in diagnosis as reported by various authors,[1, 2, 3, 4] the differentiation from a number of intrathoracic lesions frequently presents a difficult problem. The importance of establishing a correct diagnosis before operation will be brought out strikingly in the cases to be presented. Many of these demonstrate long morbidity and incapacitation or hospitalization for treatment of a condition other than the one to be discussed.

The present study is based on experience with 27 patients, 24 of which had symptoms only after the cyst had become infected. In the remaining three, symptoms were produced when intrathoracic pressures became disturbed through a check valve communication between the cyst and the tracheobronchial tree. The age of the patients extended from a few days to 59 years, most of the group being under 25 years. In those patients where operation was performed and the lesion resected, its location was fairly evenly distributed among the various lung lobes. In no case was either upper lobe alone involved. In the nine patients in whom the lesion was not resected, it was located in the right lung in six and in the left lung in three. In a review of 26 reported cases by nine authors, age distribution, duration of symptoms and location of lesion were approximately the same as in the present series.[5–13]

The gross pathologic picture in the 27 cases was classified as follows: (1) those with multiple cysts and considerable functioning lung; (2) those with multiple cysts but with little or no normally developed lung; (3) those with a large amount of abnormally developed bronchial tree elements, a number of smaller cysts and little or no normally developed terminal respiratory units. This is an arbitrary classification based on the degree and character of involvement. The patients' records illustrate that at times this factor had considerable influence on the clinical course as well as the overall pathologic picture.

Microscopically, the cysts were lined by columnar ciliated epithelium except when as result of metaplasia it had been replaced by squamous epithelium or when it had been destroyed by infection. The cysts were surrounded by a variable amount of fibrous connective tissue with bronchial wall elements such as cartilage, glands and smooth muscle in some regions. Outside of the cystic areas many small air passages lined by cuboidal or low columnar epithelium were present. The amount of this type of abnormal development varied considerably in the sections of different patients. When infection had been present throughout the lung, the usual changes characteristic of pneumonitis, such as round cell infiltration, macrophages and plasma cells, were present.

The diagnosis of congenital cystic malformation of the lung is usually not difficult, when its possibility is kept in mind. Although the clinical manifestations are produced either by alteration of intrathoracic pressures due

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to a check valve type of communication with the tracheobronchial tree or by development of infection, the clinical picture of a number of intrathoracic conditions may be simulated by this malformation. In the present study the following lesions had been diagnosed: bronchiectasis, 17; lung abscess, 10; empyema, 5; tuberculosis, 5; pneumothorax, 3; pneumonitis, 3; diaphragmatic hernia, 3, and chronic bronchitis, 1. In the collected cases reported, the experience of the authors was similar. The various conditions diagnosed before the true nature of the lesion was discovered were as follows: bronchiectasis, 4; lung abscess, 2; empyema, 4; tuberculosis, 2; pneumothorax, 1; pleuropericardial cyst, 1; in 11 cases no diagnosis was given before operation. In a number of our own cases as well as in those reported by others, treatment had been instituted for one or more of the above conditions before the true nature of the lesion was recognized. The following case reports are representative of the difficulties encountered in making a diagnosis.

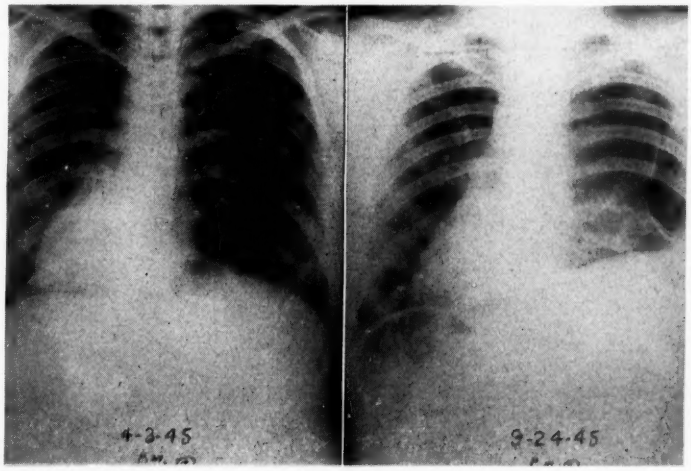

Fig. 1 *A (left).*—Chest film before resection of boy, 19, a cavity in that location draining since 12 years previously. Fluid level at cardiophrenic angle just beneath dome of diaphragm. Upper and middle lobes not entirely expanded. Fig 1 *B (right).*—Chest film after resection of right lower lung lobe; upper and middle lobes expanded.

CASE REPORTS

Lung Abscess.—An 18 year old white male complained of having had pneumonia at the age of five. Following this, a lung abscess developed and was drained through the chest wall. After a period of time the drain was removed. The symptoms of productive cough and sepsis returned, however. The abscess cavity was again drained and allowed to close on three successive occasions. The last drainage tube had been in place for approximately 12 years when the patient was first seen in this clinic. During this period he had developed normally and had no complaints other than the presence of the draining sinus.

Physical examination revealed an apparently healthy obese boy with a large tube draining a sinus at the base of the right lung posteriorly. On removing the tube, a smooth lined cavity about 2–2½ in. in diameter was visible. Several bronchial fistulas were demonstrable. X-rays following injection of the sinus with iodized oil showed a fluid level just below the dome of the diaphragm (Fig. 1 a and b). Diagnosis of congenital cystic malformation of the lung was made and the right lower lobe was resected. The postoperative course was uneventful.

The surgical specimen showed a large cyst involving about one third of the lower lobe, the remainder of the lobe being largely airless. Microscopic section through the larger portion of the lobe showed much of the lung abnormally developed. The cyst was lined with columnar ciliated or stratified squamous epithelium.

A 38 year old white female was admitted complaining of a productive cough with foul sputum of approximately one year's duration. Four weeks prior to the onset of symptoms, a tonsillectomy had been made. She had been treated with penicillin and streptomycin which gave temporary relief, and at one time a thoracentesis was said to yield frank pus. She had lost 30 lb.

On admission she appeared chronically ill, had fever of 38 C. and leukocytosis of 16,700. Hemoglobin was 11.5 Gm., and the red count 3.7 million. The positive physical findings were limited to the right chest, which showed some decrease in tactile fremitus and a few moist rales in the mid-lung field posteriorly. The sputum was extremely foul, quite thick and greenish yellow. It contained a variety of organisms commonly found in pulmonary suppurative lesions. There were no acid-fast organisms, although she had been suspected of having had tuberculosis and was kept in a sanatorium for about two weeks. X-ray examination revealed a fluid level containing cavity with a relatively small amount of infiltration around it, located in the right mid-lung field posteriorly. Diagnosis was nontuberculous lung abscess (Figs. 2 a and b). Bronchoscopic examination showed much foul thick pus coming from the right lower lobe.

She was prepared for operation by chemotherapy and blood transfusions, and the right lower lobe was removed. The upper lobe appeared normal. Her convalescence was entirely uneventful. The surgical specimen when opened showed a large cavity in the upper part of the right lung posteriorly. A moderate amount of fibrosis was present about the cavity. The lower portion of the lung appeared normal. A microscopic section made through the entire wall of the cavity revealed an abnormally developed lung with the cavity lined by columnar ciliated epithelium, except in some places where it had been replaced by squamous epithelium.

Diagnosis of lung abscess in this patient was a very natural one in view of the onset of a productive cough a short time following tonsillectomy, since that operation under general anesthesia is one of the more frequent causes of lung abscess. When the lesion did not decrease in size under medical management, in spite of the clinical picture being markedly improved, a suspicion of malformation of the lung should have been entertained. This was especially true when the patient was first seen in this clinic a year following the onset of her illness. A large pulmonary cavity presenting a fluid level, unaccompanied by sepsis or a positive sputum for tubercle bacilli, is most likely to be a congenital lung cyst.

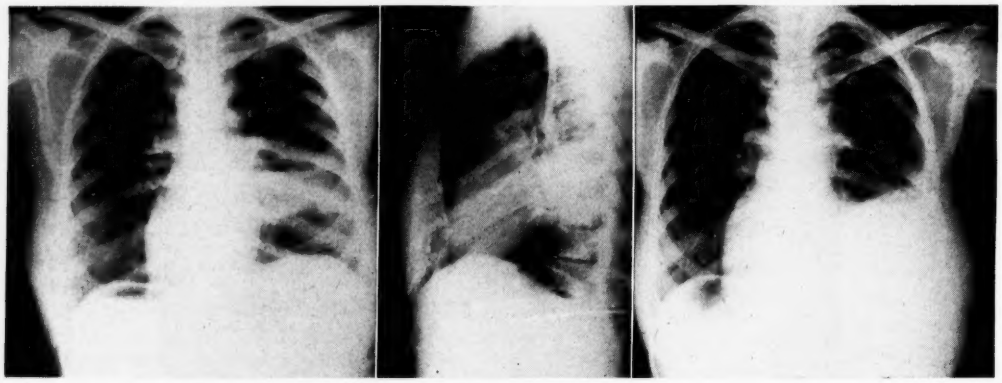

Fig. 2 *A (left).*—Anteroposterior film of chest of woman, 38, with large cavity in midright lung field, posteriorly presenting fluid level. Lesion had produced productive cough of about one year's duration; clinical picture improved somewhat by penicillin and streptomycin therapy. Fig. 2 *B (center).*—Lateral film. Fig. 2 *C (right).*—Film after resection of right lower lobe containing large cyst. Patient has remained asymptomatic since operation.

In patients having chronic pneumonitis surrounding cystic areas, the diagnosis of lung abscess is a common error. In such cases after drainage of the cavity the space does not become obliterated. If a biopsy is not taken, the true nature of the disease may remain unrecognized and a number of operations may be made in trying to heal the lesion. In such

cases the history should arouse suspicion of the possibility of the condition. When the correct diagnosis is made, operative treatment should consist of excision rather than drainage, unless contraindicated by the patient's general condition. Next to bronchiectasis, lung abscess has been diagnosed most frequently in the present series of cases prior to recognition of the true nature of the lesion.

Fig. 3 *A*.—Bronchogram; characteristic picture of bilateral bronchiectasis in woman, 25, with productive cough for 24 years.

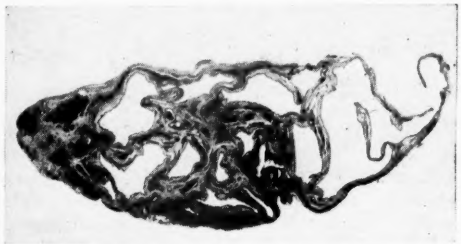

Fig. 3 *B*.—Same case as preceding. Large microscopic section of right middle lobe showing numerous cystic spaces and lack of normal lung tissue.

Bronchiectasis.—A white female, 25 years of age, complained of a productive cough with intermittent attacks of fever over a period of 24 years. She had had whooping cough at the age of 1 year and had developed pneumonia during her second pregnancy. Examination revealed a poorly nourished, chronically ill individual who coughed considerably during the procedure. Many rales were heard in both bases. X-rays following iodized oil injection showed the characteristic picture of bilateral bronchiectasis. On bronchoscopy a purulent exudate was seen coming from the bronchus of all lobes (Fig. 3 a). Diagnosis of bilateral bronchiectas was made, and she was prepared for operation. Resection of the right lower and middle lobes was carried out by the dissection technic. Her postoperative course was uneventful. Her symptoms were decreased to approximately one third of the original severity, and her general condition was good. Examination of the surgical specimen showed the lesion in the lower lobe to be saccular bronchiectasis. However, the right middle lobe was found to be made up entirely of cystic areas. Microscopic sections of this lobe showed the characteristic picture of cystic malformation of the lung (Fig. 3 b). Approximately seven months following this operation the left lower lobe and lingula were resected. She made a good recovery and has been largely relieved of her symptoms.

This patient presented the usual history and findings of bilateral bronchiectasis, the true nature of the lesion in the middle lobe being found only after the surgical specimen was examined. One might speculate as to whether infection of the cyst in the middle lobe had led to the development of bronchiectasis in the lower lobes due to repeated contamination by internal drainage.

In three other patients of the group, the middle lobe only was involved by the malformation. In these cases there was no infection in the lower lobes, and on iodized oil injection pathologic changes were seen only in the middle lobe. From our experience with the present group of cases, it would seem that when only the middle lobe is involved by a suppurative process, cystic malformation should be suspected rather than primary bronchiectasis. In patients with middle lobe involvement, internal drainage of secretions into the lower lobes may produce a picture on bronchography suggestive of tubular bronchiectasis and thus lead to the resection of normal lung tissue. At times it may also suggest that the bilateral involvement is too severe for operation. In the three patients, the middle lobe was resected, followed by complete relief of symptoms.

Chronic (Diffuse) Pneumonitis.—An 8 year old white male was first seen complaining of a productive cough with intermittent hemoptysis and

fever for approximately one year's duration. He gave a history of bilateral pneumonia with surgical drainage of bilateral empyema during the earlier part of this period. On examination he appeared chronically ill and somewhat dyspneic. The entire left lung was dull to flat, and breath sounds were either absent or bronchial in character. The right lung was normal. Laboratory findings included hemoglobin, 10 Gm.; red blood count, 3.9 million and white blood count, 14,000. X-rays showed the left lung to be entirely airless with a slight deviation of the heart shadow toward the right side (Fig. 4 a). Following injection of iodized oil, only the primary bronchi of the upper

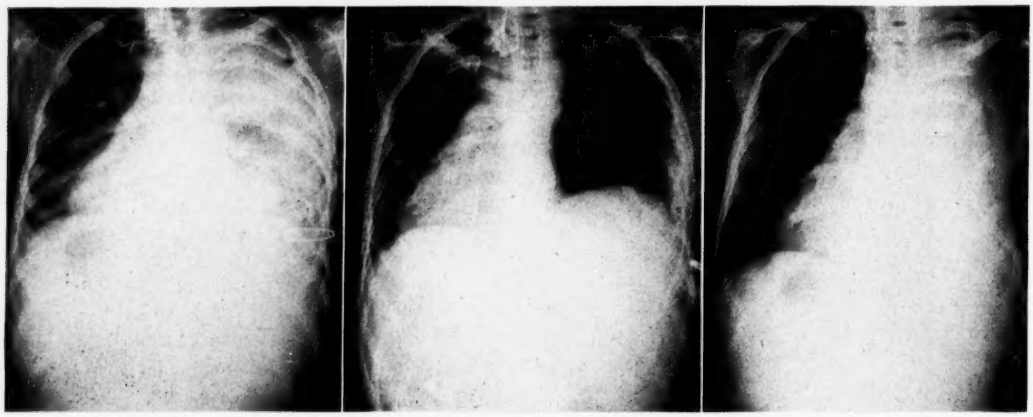

Fig. 4 *A (left.)*—Fig. 4 *B (center).*—Fig. 4 *C (right.)*—Films of chest of boy, 8, before and after resection of left lower lobe. Productive cough, fever and hemoptysis present for one year

and lower lobes were outlined. On bronchoscopic examination, some foul pus exuded from the left main stem bronchus and a large amount from the left lobe. The right side was clear. The differential diagnosis included massive empyema, chronic suppurative pneumonitis with abscess formation and possibly bronchiectasis. Pneumonitis, however, was thought to be the most likely cause of his trouble. A thoracentesis revealed no evidence of pus in the pleural cavity. Therefore, after preparation of the patient for operation by several transfusions aggregating a total of 900 cc. of whole blood and postural and bronchoscopic drainage as well as chemotherapy, an exploration was made. The left upper lobe was found to be completely atelectatic but not infiltrated or otherwise abnormal. The left lower lobe was diffusely infiltrated and airless, but no large cystic spaces could be identified. The lower lobe was removed by the dissection technic, and although the upper lobe could not be re-expanded, it was not resected.

Following operation the patient made an uneventful recovery. The upper lobe remained completely atelectatic for about four to six weeks, then became inflated spontaneously (Figs. 4 b and c).

On cut section the surgical specimen revealed several cavities filled with frank pus. The remainder of the tissue consisted of markedly fibrosed and consolidated lung. On microscopic examination the walls of the spaces were lined by columnar ciliated or stratified squamous epithelium, and various elements of the bronchial wall were present. The remainder of the lung showed abnormal development of the various lung elements, numerous small spaces lined by cuboidal epithelium and much fibrosis. There was complete lack of normally developed terminal respiratory units. The degree of infection was not so great as suspected from gross examination of the tissue.

A 10½ year old white female entered with diagnosis of chronic lung abscess of two years' duration. Two weeks prior to her pulmonary symptoms, her tonsils had been removed under general anesthesia. Following this, she began to have a productive cough of green purulent sputum, associated with fever and other symptoms of sepsis. After treatment by conservative methods for one year, a cavity in the lower part of the right lung was drained with a tube. She continued to drain from this area since, and on several occasions there have been mild hemorrhages. She lost 8 lb. and tired easily. There had been no exposure to tuberculosis.

Examination revealed a poorly nourished, chronically ill girl running a low grade fever. Leukocyte count was 8,900, hemoglobin 11.3 Gm. and red blood cell count 3.7 million. Except for clubbing

of the fingers, the positive physical findings were limited to the thorax where a rubber tube drain was seen in the seventh right interspace. Expansion of the right chest was markedly limited and tactile fremitus diminished. Breath sounds over the right chest were entirely absent and the percussion note was flat. X-rays of the chest showed a diffuse capacity involving the entire right side with what appeared to be a cavity formation in the lower portion. The left lung entirely was clear. The diagnosis was lung abscess with questionable empyema. Bronchoscopic examination revealed some pus coming from the right main bronchus.

She was prepared for operation by chemotherapy, supportive measures including blood transfusions. On exploration the entire right lung was found to be infiltrated and airless. Because the lesion involved the entire lung it was thought best to do a pneumonectomy. For the first two weeks after operation she had an uneventful convalescence, but evidence of empyema developed at that time. This was drained and subsequently a thoracoplasty was performed to obliterate the space. She has remained asymptomatic since.

On opening the surgical specimen one large, multiloculated cavity was found involving a large portion of the lung. The remainder of the lung

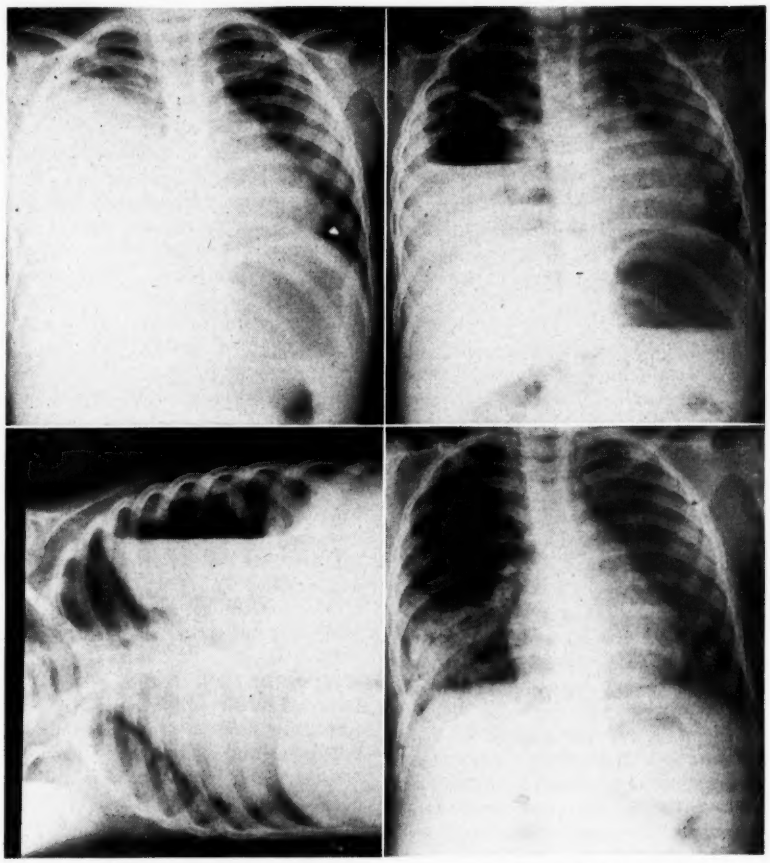

Fig. 5 *A (top, left).*—Film of chest of girl, 2, with symptoms and findings suggesting empyema following pneumonia. Fig. 5 *B (top, right).*—Fluid level after aspiration of pus and injection of air into cavity. Fig. 5 *C (bottom, left).*—Fluid level after aspiration of pus and injection of air into cavity. Fig. 5 *D (bottom, right).*—Film after drainage of cavity. Biopsy of wall showed it to be congenital cyst of lung. Resection of right lower lobe was done later, with uneventful postoperative course.

was airless, infiltrated and fibriotic. A microscopic section made through the entire lesion revealed the lining of the cavity to be columnar ciliated epithelium, except where it had been replaced by squamous epithelium. Outside of the main cavity other evidence of malformation of the lung was present.

In patients with a pathologic process such as this, it is frequently impossible to differentiate between a chronic pneumonitis and other pathologic lesions. A history of insidious onset of a pulmonary suppurative process in a child without the usual etiologic factor for the production of bronchiectasis or lung abscess should strongly suggest the possibility of congenital cystic disease. Bronchoscopic examination and x-rays following iodized oil injection are usually not diagnostic. In such cases, when the patient's condition warrants it and a thorough preparation for operation has been made, exploration and resection of the involved portion is indicated.

Empyema.—A white female 2½ years of age was admitted complaining of some difficulty in breathing and a productive cough of two months' duration. She had also had some elevation of temperature during this period. Examination revealed an underdeveloped and undernourished sickly child, whose right chest was dull to flat over the lower three fourths of the lung. A few rales were heard at the apex. Breath sounds were diminished or absent over the greater portion of the right side. The white count was 19,000. X-rays of the chest revealed complete opacity in the lower two thirds of the right lung. An empyema or a lung abscess was suspected. Frank pus was obtained on thoracentesis. After aspiration of pus and introduction of air, a large spherical space was demonstrable on x-ray (Figs. 5 a, b and c). An empyema was then diagnosed and drainage was recommended. At operation, after resecting a piece of rib, the cavity was entered. However, the wall did not appear to be that of an inflamed pleura; thus, a biopsy was taken. This showed the condition to be a large cyst of the right lower lobe lined by columnar ciliated epithelium. After the cyst had drained for about two years, resection of the right lower lobe was carried out without event (Fig. 5 d).

As pointed out by Maier and Haight,[1] large infected cysts of the lung are commonly erroneously diagnosed as empyema. In some cases x-rays following diagnostic pneumothorax may be helpful in differential diagnosis, in that the limits of the cavity may appear to be more rounded than is usually the case in empyema. Also at operation the tissue outside of the cavity does not appear to be inflamed in that it is less rigid than is the case in the wall of an empyema. A routine biopsy of the wall is usually diagnostic. Since this diagnosis is usually made in infants or small children, drainage of the cyst prior to resection may frequently be the treatment of choice. However, a correct diagnosis is necessary for determining prognosis and the planning of further care. In most reported cases the diagnosis has been made following drainage of the lesion, and resection of the lung has been made at a later date.

Pulmonary Tuberculosis.—A 50 year old colored male complained of a productive cough and fever of several years' duration. There was no history of night sweats or hemoptysis. On some occasions he had become dyspneic and had pain in the left chest. Examination revealed a chronically ill-appearing individual who coughed considerably during the procedure. Many coarse rales were heard over the left chest, and bronchial breathing was marked in the lower half posteriorly. X-rays showed marked opacity with cavity formation in the lower three fourths of the left lung. Following iodized oil injection a large cavity was demonstrable in the lower left lung and a number of smaller loculations located in other parts of the same side. A careful examination of the sputum showed several organisms which appeared like tubercle bacilli, and for a time pulmonary tuberculosis was diagnosed. Subsequent examinations of the sputum were negative for tubercle bacilli, however, and drainage of the lower cavity was planned. His condition improved, and the operation was postponed. Because of his age and general disability, resection of the involved lung was thought inadvisable. He has been seen at infrequent intervals during the past nine years and has continued to have a negative sputum for acid-fast organisms and a moderately productive cough not causing undue handicap. Final diagnosis was congenital cystic malformation of the left lung.

Five of the present series of cases and two of the reported cases had been treated for pulmonary tuberculosis before the true nature of the lesion was recognized. When the possibility of cystic malformation is kept in mind, however, this error in diagnosis is much less

likely. Three of the patients had been seen a number of years ago, before congenital cystic malformation of the lung was well known. In patients with productive cough and x-ray evidence of a cavity presenting a fluid level, a repeatedly negative sputum for tubercle bacilli should rule out the diagnosis of pulmonary tuberculosis.

Spontaneous Pneumothorax.—A 3 year old colored female was admitted complaining of a mild productive cough, fever and dyspnea of one month's duration. Shortness of breath had not been extreme at any time, and the amount of sputum raised was rather small. Examination revealed a normally developed child who did not appear ill. Positive findings were limited to the chest. Rales were heard in both lungs, and there was dullness in the lower part of the right side. Breath sounds were diminished or absent over the upper two thirds of the right lung. On x-ray examination the right lung appeared to be almost completely collapsed by a spherically shaped space filled with air. The mediastinum was not shifted whatsoever. Diagnosis was spontaneous pneumothorax. Further examination revealed no evidence of other lesions, and the tuberculin test was normal. Manometric readings showed about atmospheric pressures within the air space, the pressure decreasing on inspiration and increasing on expiration. After removing several hundred cc. of air from the space, the pressures were unchanged. Fluoroscopic examination showed the space to be the same size as before the aspiration.

On closer inspection of the x-rays it was seen that the outline of the air-filled space was oval in shape. Both at the apex and at the base there was a continuous border encircling this ovoid space. This suggested that the space was within the lung with a very thin shell of lung surrounding it. Therefore, diagnosis of congenital cystic malformation of the right lung was made.

The patient has been seen at infrequent intervals during the subsequent 10 years, and her condition has remained essentially the same. Operative removal of the cyst has been advised and rejected.

Pressure symptoms produced by large cysts of the lung usually occur in young children or infants. In former years a number of these cases have probably been diagnosed as spontaneous pneumothorax, and when complete examinations were not made, the true nature of the condition went unrecognized. Four of the present series studied, whose symptoms were produced by intrathoracic pressure changes, were three years of age or less, one being only 12 days old. The x-ray appearance of a spherical outline is highly suggestive of the presence of a large cyst, but is not always conclusive. If the condition persists unchanged for a long time, malformation of the lung is the most probable diagnosis. This can usually be determined by establishing a pneumothorax, thus demonstrating the cyst wall, or by the injection of an opaque media such as iodized oil into the cystic space and visualizing the outline of the cyst wall and trabeculae on x-ray examination.

Chronic Bronchitis.—A 16 year old white female was first seen complaining of repeated attacks of an upper respiratory infection which produced a chronic cough. This had not kept her from attending school and had not impaired her general health

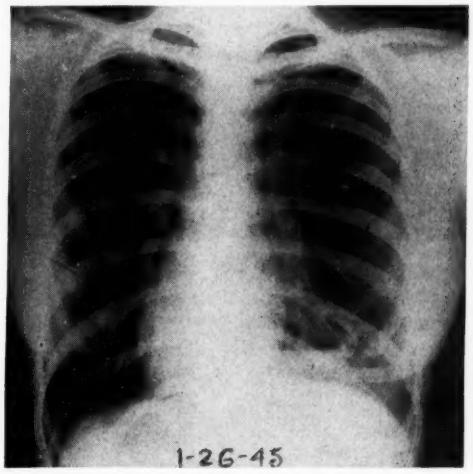

Fig. 6 *A.*—Film of chest of girl, 17, with repeated attacks of upper respiratory infection for one year. Note cystic areas with fluid levels in base of right lung.

to any considerable degree. Physical examination revealed a well developed and nourished individual who did not appear to be very ill. The general physical examination as well as that of the chest was entirely normal. Fluoroscopy showed no abnormal findings. A diagnosis of chronic bronchitis was made, and she was treated with sulfa drugs and cough medicine. She was seen at infrequent intervals and continued about the same with intermittent exacerbations of her upper respiratory in-

fection. Approximately one year later during a recurrence of her symptoms, an x-ray was made which showed two or three spherical cavities demonstrating a fluid level and located in the lower right lung field (Fig. 6 a). On physical examination a few rales were heard in the right base. The diagnosis was congenital cystic malformation of the right lung. At operation the condition was found to be confined to the right lower lobe, which was removed by the dissection technic. She made an uneventful recovery and has been asymptomatic during the two year interval since operation.

Fig. 6 *B.*—Same case as preceding; gross appearance of lesion in right lower lobe showing variously sized pulmonary cysts and considerable amount of normally developed lung tissue surrounding it.

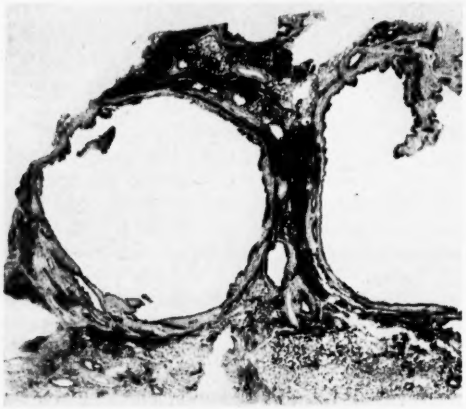

Fig. 6 *C.*—Same case as preceding; microscopic appearance of right lower lobe.

The surgical specimen contained two large and several small multiloculated cystic spaces which were almost completely surrounded by normally developed and inflated pulmonary tissue. Microscopic examination revealed columnar ciliated and stratified squamous epithelium lining the cystic spaces. A considerable amount of fibrous tissue and some abnormally developed respiratory passages were present in the walls of the cyst. However, approximately one half to two thirds of the lung parenchyma appeared to be normally developed (Figs. 6 b and c).

This case illustrates that cystic areas may be easily overlooked both on physical and fluoroscopic examination, when little or no secretion is present and where normally functioning lung tissue surrounds the cysts. Furthermore, when the cysts are located below the level of the dome of the diaphragm posteriorly, they are not demonstrable on anteroposterior x-ray views of the chest. A mild cough with little sputum may be the only symptom present. The condition may go unrecognized until infection increases the fluid contents of the cysts. A history of continued cough in children or young adults without obvious cause should be looked upon with suspicion and repeated fluoroscopic and x-ray examination made for evidence of the lesion. Treatment consists of resection of the involved part. The risk of operation is small when the patient is properly prepared. In the present group of 27 patients there were no deaths.

It has thus been shown that many conditions of the chest may be clinically simulated by cystic malformation of the lung. In addition to those illustrated by case presentation, bronchogenic carcinoma located in the periphery of the lung may easily be confused with a cyst. A fluid containing cyst may present a circumscribed opacity on x-ray examination, not dissimilar to that produced by carcinoma. Both the cyst and the carcinoma may for many months remain asymptomatic and be discovered only on routine fluoroscopic or x-ray examination. The differential diagnosis is usually made on the basis of the age of the

patient and the x-ray appearance of the lesion. If the patient is under 30, the lesion is most likely to be a cyst of the lung. On x-ray examination a bronchogenic carcinoma is more apt to have less sharply defined borders and be less spherically shaped than a cyst. In some cases a definite diagnosis cannot be established without exploration. This is indicated in either case because resection of the lesion is indicated in both.

Three patients in this study were seen in consultation with Dr. M. M. Shaw and Dr. Ed. Bryant and were treated at the Provident Hospital.

TABLE 1

CONGENITAL CYSTIC MALFORMATION OF THE LUNG

Cause of Symptoms

	Authors	Reported
Infection	24	19
Pressure	3	4
Both	0	1
Neither	0	2*

* In both cases hemoptysis was the only symptom.

Sex Distribution

	Authors	Reported
Male	13	19
Female	14	7

TABLE 2

CONGENITAL CYSTIC MALFORMATION OF THE LUNG

Age of Patients and Duration of Symptoms

	Age						
Years	0-1	1-5	6-10	11-15	16-20	21-25	25+
Authors	1	5	4	2	4	3	8
Reported	4	2	0	3	6	3	8

	Duration of Symptoms						
Authors	5	11	5	3	0	3	0
Reported	9	9	4	1	2	0	1

Age of Patients Whose Symptoms Were Caused by Pressure Changes

Authors: 12 days, 1 year, 3 years.
Reported: Newborn (2), 4th day, 26 year old (spontaneous pneumothorax).

TABLE 3

CONGENITAL CYSTIC MALFORMATION OF THE LUNG

Lobes Involved

Resected

Unilobar	Authors	Reported	Multilobar	Authors	Reported
Rt. Up.	0	2	Rt. Up. & Mid.	2	1
Rt. Mid.	2	3	Rt. Mid. & Low.	2	0
Rt. Low.	5	5	Lt. Up. & Low.	3	2
Lt. Up.	0	2	Bilateral	0	0
Lt. Low.	3	5	Entire Rt. Lung	1	1
Accessory	0	3			

Non-Resected

Rt. Lung	6	2*	Lt. Lung	3	0

Previous Operation in 24 Resected Cases in Literature

Previous drainage	8 cases
Previous thoracoplasty	1 case
Operation fatality	1 case

* Autopsy and marsupialization.

TABLE 4

CONGENITAL CYSTIC MALFORMATION OF THE LUNG

Differential Diagnosis

	Authors	Reported
1. Bronchiectasis	17	4
2. Lung Abscess	10	2
3. Empyema	5	4
4. Tuberculosis	5	2
5. Pneumothorax	3	1
6. Pneumonitis	3	0
7. Diaphragmatic Hernia	3	0
8. Chronic Bronchitis	1	0
9. Pleuropericardial Cyst	0	1
10. No Diagnosis	0	11
No. Cases in Each Series	27	26

SUMMARY

A review of 27 cases of cystic malformation of the lung revealed that a number of pathologic conditions had been diagnosed before the true nature of the lesion was recognized. In several instances treatment had been instituted for one or more of these lesions for periods of over a year. In 26 collected cases reported by nine authors, a similar experience was noted. The difficulties in differential diagnosis were based chiefly on the similarity of the clinical course with that of other pathologic conditions of the chest. Although x-ray

and fluoroscopic examination remain the best diagnostic methods for differentiation, they are not infallible and must be correlated with the clinical findings. The pathologic diagnosis is important both for an accurate evaluation of the disease and for proper surgical treatment. Since the risk of operation is small, resection of the involved lung is the treatment of choice.

SOMMAIRE

Une revue de 27 cas de malformation kystique du poumon, nous démontra qu'un certain nombre de ces cas avait été diagnostiqué faussement avant que la vraie nature de la lésion fut reconnue. Certains de ces cas avait été soumis a un traitement basé sur un faux diagnostique, pour une durée de plus d'une année. Dans 26 cas rapportes par neuf auteurs, cette expérience prévalut. Cette erreur est due à la ressemblance éxistant entre les manifestations cliniques des kystes pulmonaires et d'autres états pathologiques thoraciques. Les rayons X et l'examen fluoroscopiques sont nos meilleurs aides, ne'anmoins ils ne sont pas infallibles et il faut qu'il y est un rapport intime entre eux et les manifestations cliniques. Il est important d'évaluer et les rayons X et les signes cliniques afin d'instituer un traitement chirurgical approprié. Les risques opératoires sont minimes; la résection du kyste est le traitement de choix.

SUMARIO

El estudio de 27 casos de malformaciones quisticas del pulmon revela que son frecuentemente confundidos con otras lesiones patológicas. La radiología es aún el mejor método en el diagnóstico diferencial de estas lesiones, siempre y cuando se correlación con los otros estudios clínicos. El diagnóstico de estas lesiones es de gran importancia en el tratamiento operatorio. La resección del pulmon afectado es el mejor tratamiento, por cuanto el peligro de dicha intervención es hoy en día relativamente pequeño.

SOMMARIO

Una rivista di 27 casi di malformazione cistica al pulmone rivelano che un numero di patologiche condizione sono stati diagnosizzati primo che la vera natura della lesione e stata riconosciuta. In diverse istansi trattamenti sono stati istituiti per uno o piu di queste lesioni per periodi di piu di un anno. In 26 casi ricevuti riportati da nove autori una identica esperienza fu notata. Le difficolta in differenti diagnosi furono principalmente basati nella similarieta nel corso di clinica con quelli di altre patologiche condizione del torace. Quandunque roentgen raggio e floroscopiche esaminazioni rimone il miglior metodo diagnostico per differensazione non sono infallibili, e debbono essere correlativi con le scoperte cliniche. Le diagnosi fotologiche sono importanti tute e due per accurata evaluazione della malattia e per giusto trattamento chirurgico. Da quando il rischio di operazione e piccolo resezione del coinvolto polmone e il trattamento di scelta.

Свод

Обзор 27 случаев кистовой мальформации легких показывает до правильного распознания настоящей причины болезни был поставлен диагноз многих других патологических условий. В некоторых случаях было даже дано лечение для одного или более из этих ошибочно диагностированных болезней, и даже в продолжении более года. То же самое было найдено в 26 случаях, собранных другими авторами. Трудность дифференциального диагноза основана, главным образом, на сходстве клинической картины с другими патологическими условиями груди.

Хотя рентгенография и просвечивание являются наилучшими дифференциальными мерами, все же они не безошибочны и поэтому необходима корреляция с длиническими данными.

Патоолгический диагноз очень важен как для аккуратной оценки болезненного процесса, так и для правильного хирургического лечения. Так как оперативный риск очень мал, то резекция вовлеченного легкого считается наилучшей мерой.

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Anastomosis of Aorta to a Pulmonary Artery for Relief of Congenital Pulmonary Stenosis*

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CONGENITAL heart disease associated with cyanosis is most commonly due to the syndrome known as the tetralogy of Fallot. Of the four features of this syndrome, namely: pulmonary stenosis, interventricular septal defect, dextroposition of the aorta and hypertrophy of the right ventricle, pulmonary stenosis is the most important. The degree of cyanosis in general, but not invariably, is directly proportional to the severity of the stenosis.

The diagnosis of uncomplicated tetralogy of Fallot is not difficult. The child is cyanotic and has a red blood cell count usually of about seven or eight million. It is partially or greatly incapacitated. There is little or no enlargement of the heart. A murmur, best heard in the left second interspace anteriorly, is systolic and does not go into diastole. X-ray examination at the usual two meter distance reveals a typical boot-shaped heart with blunted apex and a concavity on the left side in the region of the pulmonary conus. A "pulmonary window" or open space, is seen best in the left anterior oblique position when viewed fluoroscopically, and in the right posterior oblique when studied roentgenographically. It signifies a smaller than normal pulmonary artery. The lung fields are clear and on fluoroscopic examination with well accommodated eyes, no pulsations can be seen. The electrocardiogram almost invariably shows right axis deviation. The chances are exceedingly good that a child with these typical symptoms has the classical syndrome of tetralogy of Fallot and may be greatly benefitted by surgery. However, there are many variations from this most typical cause of cyanosis; to select from the atypical group those patients who are remediable by surgery requires the utmost in diagnostic acumen of cardiologists trained in the study of congenital heart disease. Selection of patients suitable for operation at the Children's Memorial Hospital is done by Dr. Stanley Gibson.

The pioneering work of Blalock and Taussig [1] opened the door of hope for these hitherto helpless children, whose life expectancy without surgery was approximately 12 years. In the Blalock operation a systemic vessel is anastomosed to either the right or the left pulmonary artery to increase the blood flow to the lungs. In children under approximately two years of age, Blalock anastomoses the innominate artery to a pulmonary artery, but in older children the subclavian artery is used. Use of the innominate is associated with considerable danger of cerebral damage because the common carotid must be sacrificed in the procedure. Use of the subclavian is without danger, as collateral circulation is sufficient to nourish the upper extremity.

In 1946 a new procedure for bringing more blood to the lungs was presented.[2] It consists of anastomosing the aorta directly to either the left or right pulmonary artery depending upon the curve of the aortic arch. Since it is unsafe completely to occlude the aorta for more than a few minutes because of anemia of the spinal cord and consequent paralysis, it was obvious that such an operation would not be feasible unless a good portion of the blood could flow through the aorta while the anastomosis was being done. This was made possible by the development of a clamp which surrounds the aorta and pinches off a small portion of it to which a pulmonary artery can be anastomosed with no worry about the blood supply to the spinal cord (Fig. 1).

PREOPERATIVE CARE

The patient is routinely admitted a few days before operation, not only for further

* From the Children's Memorial Hospital, Chicago.

study but also for careful observation. The general health of patients with pulmonary stenosis is apt to be far from robust. An upper respiratory infection, however mild, is an absolute contraindication for surgery, and the operation should be delayed for at least two weeks after all signs of nasal discharge and cough have disappeared.

Penicillin, 30,000 units every three hours, is routinely given for a day or two before the operation.

Fluid balance is carefully maintained and if the operation is to be done in the morning, the child is urged to take fluids freely the previous evening.

The parents are told very frankly that the operation is an exploratory procedure and that only after the chest is opened will we be able to tell whether an anastomosis can be done. Obviously, if the child has no pulmonary artery surgical relief is impossible. To allay parents' anxiety, word is sent down to them from the operating room as soon as a suitable pulmonary artery has been identified.

ANESTHESIA

The services of an anesthetist well qualified in the intricacies of open chest anesthesia is essential. These anoxic children have a very narrow margin of safety.

The anesthetic agent of choice is cyclopropane because of the high percentage of oxygen that can be given with it. Some ether and/or nitrous oxide is often added as the patient's condition demands. The child whose color improves distinctly as soon as the anesthetic is started is less apt to have trouble during or following the operation.

Not uncommonly during these operations the child's pulse becomes slow and the systolic blood pressure falls to 50 or 60 mm. Hg. Often it is impossible to measure it at all. When this occurs, the operation is stopped and the lung re-expanded. It is surprising how promptly most children respond to increased oxygenation. Stimulation by drugs is rarely necessary or advisable; however, intravenous atropine in small doses often improves the tone of the heart beat and quickens a slowing pulse.

An important aid to the surgeon is a quiet chest. To accomplish this, the anesthetist takes over the patient's respiration by rapid intermittent pressure on the anesthetic bag. If it is impossible to "breathe for the patient" this way, curare in small amounts is given intravenously and repeated as necessary.

At the close of the operation the patient is slowly turned from the lateral to the supine position. Too rapid turning has in a few cases resulted in an alarming drop in blood pressure and marked weakening of the pulse rate.

Details of the technic of anesthesia for patients being operated upon for pulmonary stenosis are many and demand the finest judgment. Dr. William O. McQuiston has given all the anesthetics for these operations.

TECHNIC

As soon as the child is anesthetized, an intravenous cannula is inserted into the saphenous vein at the ankle and a slow drip of glucose or physiologic solution of sodium chloride started. A unit of plasma is sometimes given. Intravenous medication, if necessary, is given by this route. The child is then turned on the right side if the arch is on the left, and on the left side if the arch is on the right.

The skin is prepared with ether, iodine and alcohol. A curved incision is made below the scapula from the edge of the erector spinae muscles to the anterior axillary line (Fig. 1). The muscles are cut and the chest entered through the fourth interspace. It is unnecessary to cut or remove any ribs in children under 10 years of age. The lung is collapsed, packed out of the way with a wet abdominal pad and held with a malleable retractor. The assistant must be warned not to allow the edge of the retractor to touch the heart or its rhythm will be disturbed.

The hilus of the lung is at once explored. Sometimes a pulmonary artery is immediately visible, but in some cases, especially in those with a small pulmonary artery or an atresia at the conus, the region of the hilus appears at first to be nothing but a mass of tortuous thin-walled blood vessels which bleed on the slightest manipulation. The loss of a little blood in these plethoric children is less serious than in a normal child. With a fair degree of confidence these small vessels are dissected from the hilus; the tiny ones are disregarded, the larger ones are tied with fine silk. We use no sponges in the chest. Instead, we wash the area being worked on with a stream of physiologic

saline solution forced from a 50 cc. bulb syringe. The water is removed from the chest with an aspirator. Lavaging the tissues is less traumatic and far more effective than sponging, because water washes the dark blood out of the meshes of adventitial tissue and thereby permits ready identification of hilar structures. The pulmonary artery is dissected free proximally as far as possible, and distally into the hilus of the lung just beyond the point where it breaks into separate branches. Doubly encircling ligatures of oiled no. 00 silk are placed around the most distal portion of the pulmonary artery. If the pulmonary artery breaks up into branches at the margin of the lung, each branch is doubly encircled with a separate ligature. A doubly encircling ligature is also put around the pulmonary artery as far proximally as possible. All the occluding ligatures are laid aside.

The aorta is now dissected from its bed. A line of cleavage between the parietal pleura and the adventitia is easily identified. From three to five intercostal arteries require double ligation and cutting to make room for the aortic clamp. At this point in the operation, the lung is usually re-expanded for a few minutes to improve temporarily the patient's oxygenation.

The clamp is now applied to the aorta. In three patients under one year of age the smallest size clamp was used. One child 12 years of age required the largest size clamp. On all the rest

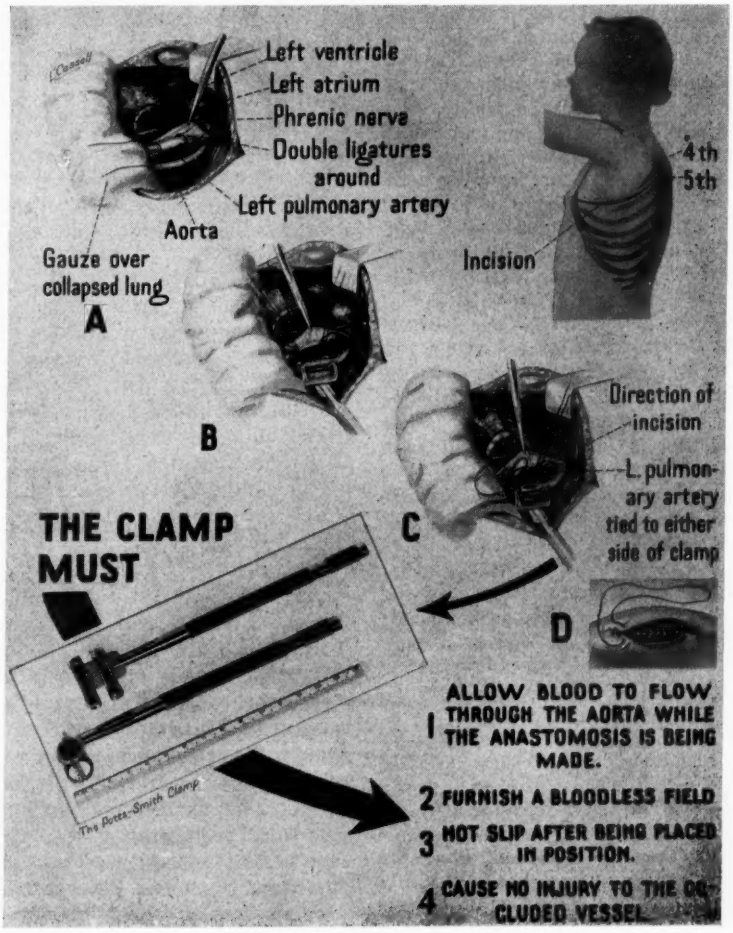

Fig. 1.—See text.

of the patients the middle size aortic clamp was used. As the flanges of the clamp are being brought together, the adventitia of that portion of the aorta which is to be occluded is grasped and gentle traction is made in order that a fair-sized lip of aorta will protrude from the closing flanges. So long as one can palpate a definite thrill over the aorta *distal to the aortic clamp after it has been tightened,* one may be sure that sufficient blood is flowing through the aorta to nourish the spinal cord.

The cut in the aorta is made between 5/16 in. (8 mm.) and 4/16 in. (6.5 mm.) long, measured accurately with a caliper. It is extremely important to flatten the rounded portion of the protruding aorta, while the incision is being made, with a small bladed knife in order that the aortic wall will be cut squarely. The incision in the aorta is enlarged to proper length with a fine scissors, as described in an earlier publication.[2]

The pulmonary artery is tied to the clamp as illustrated in Figure 1. One end of the ligature, doubly encircling the distal end of the pulmonary artery or a branch of it, is threaded through the posterior lip of the clamp in one direction and through the anterior lip of the clamp in the opposite direction. The other end of this same ligature is carried through the lips of the clamp in the opposite direction. The ends of the ligature are then tied snugly to the clamp to appose the pulmonary artery to the aorta in the best position for the anastomosis. The ligature about the proximal end of the pulmonary artery is tied to the other end of the clamp in a similar manner.

The incision in the pulmonary artery is made a little shorter than that in the aorta because it tends to stretch a bit during the anastomosis.

There has been no change in the method of continuous over-and-over suture with no. 5–0 Deknatel braided silk on a curved no. 9 atraumatic needle.

After completion of the anastomosis, the pulmonary ligatures are removed, then the clamp is released and removed. A palpable continuous murmur signifies that blood is flowing through the new anastomotic channel. Only two cases required one extra stitch to stop bleeding from the anastomosis.

The chest is closed in layers. A small intercostal drain is placed in the chest and left there for three days attached to a water seal. The child is slowly turned to the supine position, returned to its room and placed in oxygen for one to three days. Penicillin, 30,000 units every three hours, is given for 7–10 days. Food and fluids are taken as the child wishes. Until an adequate amount of fluid is being taken by mouth parenteral fluid is given.

Five patients had right aortic arches. In each case an anastomosis between the aorta and the right pulmonary artery was satisfactorily completed, although the operation is more difficult when the aortic arch curves to the right. In no patient with a large enough pulmonary artery was an anastomosis technically impossible.

POSTOPERATIVE COMPLICATIONS

These have not been troublesome. It seems that if the child survives the operation and wakes up promptly following operation, the outlook is good. Aspiration of fluid and/or air from the chest was necessary in four cases. All occurred before it became routine to put a drain in the chest upon completion of the operation.

One child had severe anoxia causing cerebral edema and unconsciousness for three days. Recovery was complete. Two children had tracheobronchitis and laryngeal edema postoperatively. One of these children required tracheotomy. At the first sign of tracheobronchitis the child is moved to a steam room.

MORTALITY

Aortic pulmonary anastomosis was completed in 36 children of whom 4 died, a mortality of 11.1 per cent. There was 1 death in 10 children under 2 years of age. Three of these children were under 1 year of age, 4, 6, and 8 months, respectively. In a group of 14 children between 2 and 5 years of age there were 2 deaths. In the group of 12 children between 5 and 12 years of age there was 1 death.

The causes of death determined at autopsy were cerebral thrombosis in two cases; both of these children had had previous hemiplegia and died shortly after operation of further cerebral thrombosis. One child died of cardiac arrest 18 hours postoperatively, presumably due to tension pneumothorax. The fourth death (autopsy refused), probably due to hemorrhage in the hypothalamus, occurred on the third postoperative day. There were five exploratory operations. Because of absence of pulmonary arteries no anastomosis could be done. Two of these patients died on the operating table. In both, autopsy revealed atresia of the pulmonary artery. All the

blood to the lungs was derived from bronchial arteries.

FOLLOW-UP RESULTS

A complete follow-up study of 32 patients who survived operation is being made now. In general, the results have been pleasing. Thirty children have been tremendously improved. Their color is good, they eat well and they run and play like other children. For psychologic reasons we have not restricted their activity. All anastomotic channels have remained open as indicated by improved color and the presence of a continuous murmur going through systole and diastole. Two children are improved, but have some persistent cyanosis.

SUMMARY

The author describes his technic of anastomosing the aorta directly to either the left or the right pulmonary artery, depending on the curve of the aortic arch, in children with tetralogy of Fallot. Postoperative complications have not been of major importance, and mortality in a group of 36 children was 11.1 per cent. Of the group of 36, 30 children have been tremendously improved and two are improved but have some persistent cyanosis.

SUMARIO

El autor describe su tecnica de anastomosis directa de la aorta a una de las arterias pulmonares. Las complicaciones post-operatorias no han sido de gran importancia y la mortalidad en 36 ninos fue de 11.1 por ciento. De 36 ninos que presentaron el sindromo de Fallot 30 obtuvieron gran mejoria y solo dos sufren aun de cianosis persistente.

SOMMARIO

L' autore descrive da sua tecnica di anastomosi l' aorta diretta sia alla sinistra o alla destra arteria polmonare dipendente alla curva dell arco aortico in bambini con tetralogia di Fallot. Complicazioni dopo la operazione non sono state di maggiore importanza, e mortalita in un gruppo di 36 bambini e stata dell 11.1 per cento. Da gruppo di 36, 30 bambini sono stati trementosamente migliorati e due sono migliorati ma hanno un po di persistente scura.

SOMMAIRE

L'auteur décrit sa technique pour l'anastomose de l'aorte à l'autère pulmonaire droite ou gauche selon la courbure de l'arcade aortique chez les enfants présentant la tétralogie de Fallot. Les complications postoperatoires ne furent pas d'une importance majeure. Dans un groupe de 36 enfants la mortality fut de 11.1 pour cent. Sur les 36 enfants, il y eut une amélioration notable chez trente enfants. Dans deux cas il y eut une amélioration mais un degré de cyanose persiste.

Свод.

Автор описывает его технику анастамоза аорты и, в зависимости от линии дуги аорты, правой или левой легочной артерии в детях с тетралогией Fallot'a. Послеоперативные осложнения не были очень важными, и смертность в группе 36 детей была 11,1%. Из 36 детей 30 приобрели громадное улучшение. 2 тоже улучшились, но с небольшим остающимся цианозом.

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Surgical Papers in Abstract Form by Former Students of Prof. Jirasek

I.—Personal Experience with Prefrontal Leucotomy, Prof. J. Knobloch.

The author gives an account of his surgical experiences with prefrontal leucotomy, performed in 103 cases with mental diseases. He used Moniz's method in 26 cases, Freeman-Watts method in 52 cases and Duff's modification in 25 cases. The technic of the three operative methods is described, together with the postoperative course, complications and end-results. In the series treated by the Moniz method, the postoperative course was smooth, and there were no deaths. Substantial improvement occurred in 3 cases, and partial improvement in 12. With the Freeman-Watts method, there were 3 deaths, 8 cases of substantial improvement and 30 cases of partial improvement. Of the 25 cases treated by Duff's modification, there were 1 death, 5 cases of substantial improvement and 11 cases of partial improvement, the remainder showing no changes. These results were confirmed by Dr. Semotan, a psychiatrist, who worked with the author on these cases.

II.—Some Notes on Millin's Method of Retropubic Prostatectomy, Prof. Kovařovic.

The author renders a preliminary report on the present-day experience with Millin's method of retropubic prostatectomy. He stresses the advantages as well as the pitfalls of the operation. The results were found good in 36 per cent of cases and satisfactory in 16 per cent, while in the rest complications of urinary fistula and of periostititis of the os pubis occurred. All patients so treated recovered save one, who died on the fourth postoperative day of heart failure. The average postoperative hospital stay was 30 days.

III.—The Prolongation of the Coracoid Process in Habitual Dislocation of the Shoulder, Prof. J. Barta.

The extension of the coracoid process has proved successful in 10 cases of habitual dislocation of the shoulder so treated surgically. In three other cases it was not successful. The presence of a spinal cord lesion was responsible for redislocation in one of these three poor results.

IV.—Spontaneous Fractures of the Ribs after Deep X-Ray Therapy, Prof. V. Švab.

The findings of three patients who received deep x-ray therapy for cancer of the breast several years ago are reported. There was a break in continuity in one rib in the first case; in several ribs of the same half of the chest wall in the second case, and in several ribs of both sides of the chest wall in the third case. In none of the cases was there a history of injury to the chest wall at any time.

All therapy had been given two to three years prior to the time of fracture. Treatment consisted of a total dosage of 6,000–10,000 r, and was applied from two fields 20 x 24 cm. within a period of two years. All three patients felt pain of different intensity in the chest, which led to the diagnosis of fracture. X-ray studies of the chest revealed no callus at the fracture site, and repeated studies over a period of nine months failed to show any healing by callus formation. Cessation of osteoplastic activity as a sequela of large x-ray dosage with continuance of the osteoplastic activity is given by the author as the cause of the pathologic fractures.

V.—Possibilities of Operative Treatment of Duplay's Disease, Docent B. Niederle.

Investigations of the various causes that lead to the syndrome of periarthritis humeroscapularis enables us to replace this term with a more exact diagnosis. Differentiation of the various disturbances in the region of the so-called subacromial secondary joint can be made. Our own operative findings disclosed the chief type of abnormality to be fresh tears of the tendon of the supraspinatus muscle, degenerative and proliferative changes in the

bicipital groove with damage to the biceps tendon, rupture of the coracoclavicular ligaments with luxation of the clavicle and bilateral acute subacromial bursitis following extrusion of calcified particles from the tendon. According to the changes found, and even from the presenting symptoms, three groups can be distinguished. The first is affections of the tuberculum humeri with their tendon and capsule insertions; second, affections of the bicipital groove with its tendons, and third affections of the secondary subacromial joint with its bursae. The disturbances are traumatic, degenerative or inflammatory in origin. Apart from conservative treatment, surgery is sometimes successful. Fresh tears are sutured, while in an older tear with degenerative changes the removal of all uneven surfaces and incrustations is preferred. For acute bursitis, extirpation or evacuation of the bursal sac is performed. With this the results are best and immediate. As regards infiltration with novocaine, in fresh cases we prefer to inject the subacromial joint rather than using infiltration of the painful area itself. In chronic cases injection into the region of the stellate ganglion is more likely to help.

VI.—Possibilities of Therapy of Local Recurrences and Accessible Metastases by X-Ray Contact Irradiation, Docent R. Blaha.

A report is made of the immediate results of contact irradiation of superficial metastases and recurrences of malignant tumors. Irradiation was given to 12 patients with recurrence following amputation of the breast, 1 case following excision of cancer of the lip, 1 case following thyroidectomy for a malignant struma, 1 case with multiple recurrences secondary to cancer of the face and 1 patient with recurrence of sarcoma of the sternum.

In all cases save two such irradiation caused the superficial recurrences to disappear. The results, however, do not signify lasting recovery, for deeper metastases in distant organs dominate the picture, and for such patients the treatment is without effect.

VII.—Causes of Segmental Dilatation of the Kidney Pelves, Docent V. Pačes and Assistant O. Koref.

The isolated dilatation of one or more calices of the renal pelvis, which sometimes originates from unknown causes and which is termed idiopathic segmental dilatation, is very probably the result of one or more diseased renal papillae. This begins with a blockage of the excretory channels. At the beginning, the calyx reacts against this block by increased function and finally dilates through fatigue. Fundamentally it is a case of dilatation due to obstruction. Such, for instance, is the case when ligature of the neck of the kidney pelvis is done in subrenal section of the ureter. The authors are of the impression that the papilla is most frequently damaged by some extrarenal causes that lead to nephrolithiasis. Therefore the treatment of such segmented dilatation should aim primarily at removing these causes. In the case of prolonged pain they recommend: (1) paravertebral anesthesia of the diseased kidney; and (2) decapsulation of the diseased kidney. An attempt is always made to eliminate the specific process affecting the papilla.

VIII.—Operative Findings in the Concussion Syndrome, Docent J. Šejhar.

Out of 280 cases of concussion syndrome that were closely observed, 70 cases demanded surgical attention. Of these, 19 cases required early operation because of increasing symptoms. Besides that of a continued change for the worse in the vegetative state and other neurologic changes, the symptoms which particularly demanded surgical intervention were the following: (1) deep unconsciousness lasting over 12 hours; and (2) acute rise in intracranial pressure (over 250 mm. H_2O within 12 hours following the accident).

In all cases the first measure taken was to bore a number of trephine holes under local anesthesia or performing, when necessary, the usual decompression by trepanation. The findings at operation showed what conditions may be hidden behind a concussion syndrome with increasing symptoms and protracted un-

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The Use of Propylthiouracil in Hyperthyroidism*

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ONE hundred and fifty cases of hyperthyroidism have been treated with propylthiouracil at the Jackson Clinic since January, 1946. In this series no case of agranulocytosis or of any other form of serious reaction has occurred. In one instance in a girl, 7 years old, with exophthalmic goiter, the white blood cell count dropped to 2,500; the drug was discontinued.

This experience coincides with that of others who have been investigating this drug. At the recent meeting of the American Association for the Study of Goiter, Astwood [1] reported a series of 200 cases of hyperthyroidism treated with propylthiouracil without any serious complications. Bartels [2] of the Lahey Clinic used the drug in 300 cases with but one nonfatal case of agranulocytosis. At the time of this meeting Stanton Hardy,[3] director of scientific research of the Lederle Company, estimated that approximately 1,500 cases of toxic goiter had been given this drug with but one reported case of agranulocytosis. McGavack and his associates observed one instance of a severe febrile reaction in 100 patients to whom the drug was administered.

From these reports, as well as from the observation of others interested in the study of propylthiouracil, it is apparent that this drug is far safer than thiouracil. My experience with the latter drug was limited to a study of only 50 cases; because of the large number of complications and the relatively high incidence of mortality reported in the literature, its use was entirely discontinued at our clinic in January, 1946. In my experience with thiouracil no serious complications occurred, but its disadvantages were such that it was entirely abandoned for the less dangerous propylthiouracil.

In the year and a half that has elapsed since propylthiouracil became available for clinical investigation, probably over 2,000 cases of hyperthyroidism have undergone treatment with the drug. In the few reports that have appeared in the literature, no one has attempted finally to evaluate this method of therapy. Thus, such reports as "the drug is safe and effective for the management of all forms of hyperthyroidism" have appeared. Just what is meant by management? Obviously, we are primarily interested in the cure and not the control of this disease. It may be stated as a fact that propylthiouracil, thiouracil and any other known drug will not cure multiple toxic adenoma. The metabolic rate may be brought to normal and the patient's condition greatly improved, but it will still be necessary to remove the adenomata in order to prevent the various complications resulting from the condition. Probably the greatest value of this drug is in the improvement it brings about in the advanced cases of hyperthyroidism in adenomatous goiter.

Will this antithyroid drug cure exophthalmic goiter? I do not believe sufficient time has elapsed to answer this question positively. At the present time I have stopped the drug in the treatment of 35 patients who had received it for approximately a year. One of these cases was in a 12 year old girl who took the drug for 14 months. During that time her basal metabolic rate dropped from +47 to 0 per cent; she gained 15 lb. in weight and was able to resume her school work. There was no marked enlargement of the thyroid gland, and for this reason I am hopeful that she may have a permanent remission. If the drug fails in her case, then I do not believe that it will cure many primary cases of exophthalmic goiter. It effects a cure in a postoperative, persistent or recurrent case just as thiouracil, iodine or x-ray therapy occasionally do. Some of these patients get well if nothing is done. Another case of interest was that of a 14 year old girl with

* The Frieda Meyers Nishan Foundation for the Study of Goiter of the Jackson Clinic, Madison.

a very large exophthalmic goiter. She likewise received treatment for nearly a year, but, since the pathologic picture is not materially altered by the drug, there was little change in the size of the gland, although all symptoms of hyperthyroidism were controlled. Thus, it may be said of this patient that the drug proved effective for the management of the hyperthyroidism but failed to effect a cure; thyroidectomy was therefore performed and a permanent remission produced. I say permanent with some reservation because we know too well the tendency of this disease to recur, especially in children. One should always speak of a cure in exophthalmic goiter with reservation.

Bartels has definitely concluded that propylthiouracil will not effect a cure in primary hyperthyroidism. I am beginning to believe he is probably correct. However, no one has reported a case treated for a year or more with this method without stopping the drug, although undoubtedly some investigators have done this. Treatment for a few months means little as far as judging the permanent effect of this treatment is concerned.

The next problem that arises is the effect of continuing the patient on treatment for several years. If the metabolism can be returned to normal and if all symptoms of hyperthyroidism save an enlarged thyroid gland disappear, is there any objection to continuing the treatment indefinitely? For years we have successfully controlled certain cases of postoperative, persistent or recurrent hyperthyroidism with iodine. This is done with little risk, although in some instances hyperthyroidism is not absolutely controlled and eventually cardiac damage may result.

Although propylthiouracil has proved a comparatively innocuous drug since its clinical investigation was begun in 1946, all investigators are not in accord with this opinion. At the recent meeting of the American Association for the Study of Goiter, George Curtis of Columbus stated that he was concerned over the possible harmful effects of both thiouracil and propylthiouracil on the bone marrow. Astwood and Means thought that this apprehension was unwarranted, and no harmful effects had been observed in their experience, so far as propylthiouracil was concerned. Nevertheless, in the present state of our knowledge, it is essential that patients receiving this therapy be observed at intervals not to exceed four weeks, and that the white blood cell count be carefully observed. Such frequent observations entailing, as they may, much travel, time and expense may preclude prolonged treatment with this drug.

From my observation with the use of propylthiouracil in a series of 150 cases in the past 1½ years, I have reached the following deductions:

1. The incidence of reaction is far less than it is with thiouracil; it is a much safer drug.
2. As a consequence, it has been released to the general medical profession, and thiouracil should be withdrawn.
3. Clinically, propylthiouracil will accomplish everything that thiouracil will do.
4. While it will restore the metabolic rate to normal and control hyperthyroidism, it will not materially alter the size of the gland or change the pathologic picture.
5. It greatly increases the vascularity of the gland and increases the tendency to bleeding at the time of operation.
6. This tendency to bleed may be counteracted by administering iodine simultaneously and preferably stopping propylthiouracil a few days prior to thyroidectomy.
7. The drug is especially useful in the preparation of the poor risk case of toxic adenoma and in the case complicated by such conditions as cardiovascular change, diabetes and senility.
8. It is valuable in iodine-fast exophthalmic goiter; the patient is given a rest from iodine for a period of weeks or months and then is given iodine again for 10 days prior to operation.
9. Extremely toxic cases of exophthalmic goiter or unfavorable risk cases in the young or aged may be brought into favorable condition by the combination of propylthiouracil and iodine.
10. If iodine has been given for some time, there will be slower response to the drug. Although clinical improvement may slowly occur, the metabolic rate may be expected to rise for some weeks before it begins to fall.

This rise should be disregarded and treatment continued.

11. The dose of the drug which I am using at present is 50 mg. three times a day until the basal metabolic rate approaches normal, at which time a maintenance dose of 50 mg. a day is given. In some instances larger doses of the drug are used.

12. The use of propylthiouracil and iodine has largely eliminated the need for a two-stage thyroidectomy.

13. To effect a prompt and, in a high percentage of cases, a permanent restoration of health in hyperthyroidism, thyroidectomy preceded by the proper preoperative preparation is still the most satisfactory treatment.

14. In the postoperative care of exophthalmic goiter, both in the immediate and the prolonged treatment, iodine alone is used as indicated.

SUMMARY

It may be said that propylthiouracil is the most effective medical method available in the treatment of hyperthyroidism since the introduction of Lugol's solution by Plummer in 1922.

SOMMAIRE

On peut affirmer que le propylthiouracil est le médicament le plus efficace disponible pour le traitement de l'hyperthyroïdisme presenté à la profession médicale depuis l'introduction de la Solution Lugol par Plummer en 1922.

SUMARIO

De acuerdo con el autor, se puede decir, que el propiltiouracilo, es hoy en dia, el medicamento mas efectivo en el tratamiento del hipertiroidismo.

SOMMARIO

Forse sara detto che propylthiouracil e il piu effettivo metado medico per la cura del ipertiroidismo da quando la introduzione del Lugol's soluzione di Plummer nel 1922.

Свод

Можно сказать, что со времени введения раствора Лугола Плуммером в 1922 г., пропилтиоурасил является наиболее эффективным медикаментом для лечения гипертироидизма.

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ABSTRACTS

(Continued from page 575)

consciousness. In eight of the cases a serous meningitis was found; in 5 cases hypersecretion and in six cases cerebral edema were present. Neurologic changes and changes in the rise of intracranial pressure were thoroughly studied.

IX.—Cerebral Abscess, Assistant J. Zucha.

A report of seven cases of cerebral abscess treated with penicillin is presented. The mere hypodermic administration of the antibiotic does not completely control the disease. In addition, surgical intervention is necessary. A single aspiration of the abscess without drainage according to the method of Dandy proved to be the simplest and most effective. After the aspiration, penicillin is placed directly into the abscess cavity in 100,000 unit amounts. This tends to sterilize the abscess. The administrtaion of penicillin by intraspinal or intraventricular route is justified in cases of a perforating abscess or a coexisting meningitis. Of the localizing signs, stress is laid on the importance of painful percussion at the site of the cerebral abscess. Combined local and systemic treatment with penicillin in two cases of cerebral abscess with perforation into a cerebral ventricle proved successful. In the entire series there was only one death.

Some Clinical Entities Frequently Misdiagnosed

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I have come in contact with many of Professor Jirasek's former pupils. All spoke of their Master with esteem. All bore an enviable imprint that must serve them well in whatever part of the world they practice: even a casual observer could not fail to detect in them the stamp of a sound training in physical methods of examination and surgical diagnosis. So it came about that, when I was asked at short notice to make some contribution to the Jirasek number of the JOURNAL, I chose a subject that I imagined would interest the Professor's students.

* * * * * * * * * *

Preauricular Sinus.—A patient complains of an abscess, often a recurrent abscess (Fig. 1) or, more usually, a cutaneous ulcer immediately in front of the tragus. Such findings should suggest at once the clinical entity "preauricular sinus," which is the result of imperfect embryological fusion of the five tubercles that form the pinna.

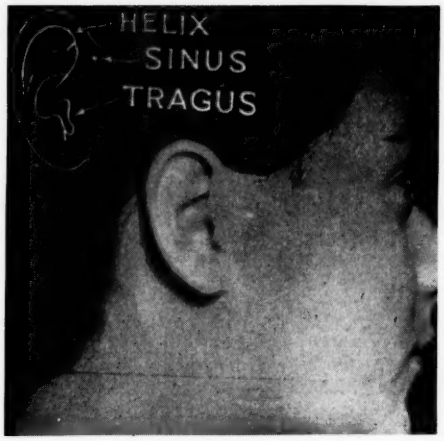

Fig. 1.—Recurrent preauricular abscess. Patient says abscess has been opened on five occasions during past six years. Opening of sinus can be seen on root of helix.

On scrutinizing closely the root of the helix and the top of the tragus, the tiny opening of the congenital epithelium lined sinus can usually be found; in our case this opening is situated in the root of the helix. Unless the whole of the fistulous track is excised, abscess will follow abscess, or an ulcer, if present, refuses to heal.

Preauricular Lymph Node?—This patient has a firm, rounded, solid swelling in exactly the same position as the first patient had an abscess, i.e., immediately in front of the tragus (Fig. 2). Four experienced postgraduate students examined the swelling and unanimously considered it to be an enlarged preauricular lymph node. None of them noticed that, when the patient opens his mouth, the swelling is thrown into prominence by the condyle of the jaw (Fig. 3). Not that this has any diagnostic significance, but it does enable one to palpate the swelling more thoroughly.

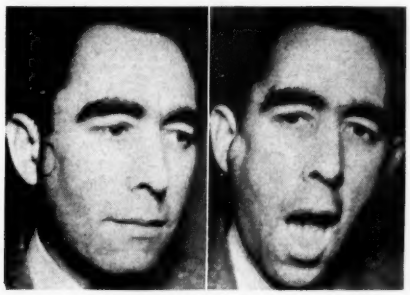

Fig. 2 *(left).*—Note swelling in front of tragus. Fig. 3 *(right).*—When patient opens his mouth, swelling is thrown into prominence by downward movement of condyle of jaw.

Enlargement of the preauricular lymph node is nearly always due to an infected lesion situated in a circumscribed area, centered around the outer third of the eyebrow. No trace of such an infection is present in this case, and the lump, the patient says, has been present and has not altered in size for over six weeks. I venture to suggest that the swelling is too hard to be accounted for by a pyo-

genic lymph-adenitis. I do not deny that it might be tuberculosis, but I think this is unlikely because there are no other palpable glands in the neighborhood or in the neck.

I therefore consider as the most probable diagnosis that the swelling is a mixed parotid tumor. Indeed, this is the second commonest location for the beginnings of this neoplasm. As is well known, by far the most common initial location of a parotid tumor is just in front of the lobule of the ear.

(The lump was excised and proved to be a typical mixed tumor.)

Median Mental Sinus.—The patient has a discharging sinus on, or less frequently just below, the chin (Fig. 4), but always in the middle line. Often there is a history that

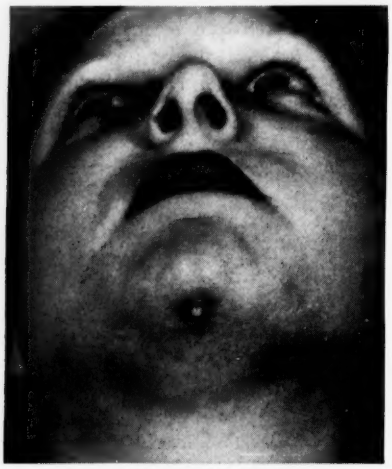

Fig. 4.—Median mental sinus.

it has been scraped and packed, perhaps several times. An x-ray of the bone in the immediate neighborhood reveals no abnormality, but a film of the lower incisor teeth which, on clinical examination, sometimes appear to be sound, shows an area of rarefaction around the roots.

Median mental sinus is a distinct clinical entity. The pus from a paradental abscess connected with the lower incisor teeth tracks between the two halves of the lower jaw to the point of the chin. After extraction of the infected tooth or teeth, the sinus heals within a fortnight.

Tumor of the Submaxillary Salivary Gland.—Neoplasms of the submaxillary salivary gland are not particularly uncommon; nevertheless, of the considerable number of examples of this condition that I have seen, I cannot recollect a single instance where a correct diagnosis had been made by the attending practitioner or by students examining the patient, unless, of course, the growth had fungated through the skin, or the tumor had reached such dimensions as to make the diagnosis undeniable. The regularity with which mixed tumors of the submaxillary salivary gland are overlooked in their very patent stages of development cannot be brought home better than by the following incident:

Not long ago, a busy practitioner consulted

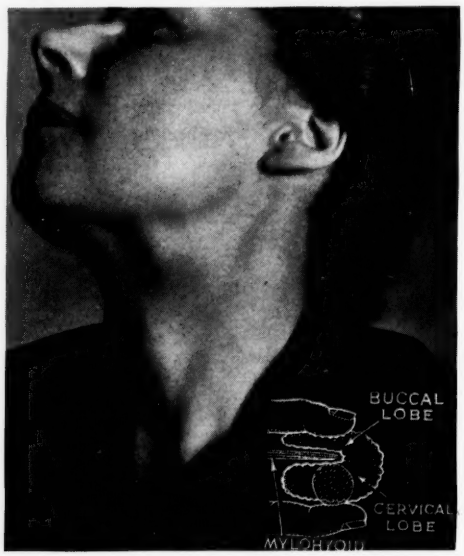

Fig. 5.—Swelling in submaxillary triangle present for five years. Patient states that lump does not vary in size and is quite painless.
Inset.—Bimanual palpation revealed these findings.

me about a paronychia. While agreeing with the diagnosis and the necessity for early operative treatment, I said to him: "How long have you had that swelling in the submaxillary triangle?" He rubbed the swelling with his sound hand, and exclaimed: "Oh, that is nothing. I suppose it is a tuberculous gland, but I have had it for several years, and it gives me no trouble." I examined the swell-

ing, and on bimanual examination with one finger in the mouth it was quite evident that the lump was situated in the cervical portion of the submaxillary salivary gland.

The patient shown in Figure 5 again emphasizes the point that I wish to make. In spite of the fact that this swelling has been present for five years, three competent postgraduate students proclaimed it to be either a tuberculous lymph node or a swelling of the submaxillary salivary gland due to a calculus. The latter diagnosis is absurd, because (1) saliva can be seen flowing from Wharton's [1] duct of this side, (2) the patient has never had any pain in this area and (3) the swelling has not varied in size. The diagnosis of tuberculous lymph node is rendered improbable, if we perform really efficient bimanual palpation. With one finger in the mouth and two fingers of the other hand over the lump in the submaxillary triangle, without stretching my imagination, I can actually feel a hard, lobulated swelling in the larger cervical lobe, as opposed to the smaller buccal lobe of the submaxilary salivary gland (Fig. 5, *inset*). The lump is certainly hard and rounded, but not hard enough to be a giant stone, and in my view there is absolutely no reason for not making a perfectly confident diagnosis of mixed tumor of the submaxillary salivary gland.

(The submaxillary salivary gland was removed, and the diagnosis proved to be correct.)

Long-Stemmed "Collar Stud" Abscess.—By far the most common cystic swelling in the neck is a "collar stud" abscess (Fig. 6) connected with tuberculous lymphadenitis; the diseased gland or glands beneath the cervical fascia are connected by a small opening in the fascia to a more superficially placed "cold" abscess.

In about 10 per cent of cases, the stem of the "collar stud" (Fig. 7) is long; i.e., the tuberculous glands [2] that feed the abscess are situated some distance away (Fig. 8), perhaps in another triangle of the neck. I note repeatedly that senior students, and even postgraduates, usually declare that long-stemmed "collar stud" abscesses are a novelty to them. This is after they have overlooked the causative lesion, or have failed to associate it with the abscess.

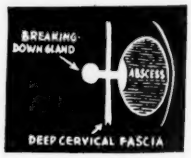

Fig. 6.—Blackboard sketch of "collar stud" abscess.

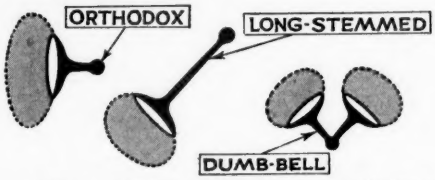

Fig. 7.—"Collar stud" abscess. Orthodox and and variations.

Fig. 8.—Long-stemmed "collar stud" abscess. Abscess is in lower third of neck. The mass of breaking-down glands can be felt beneath sternomastoid in position indicated.

Fatty Hernia of the Linea Alba.—There are many methods of rendering the musculature of the anterior abdominal wall tense with a view to differentiating an intra-abdominal swelling from a swelling in the anterior abdominal wall itself. The test I favor is to instruct the patient to pinch his nostrils, tell him to close his mouth tightly and then to blow with all his might. Perhaps the most frequent call for this type of test is when

[1] Thomas Wharton, 1614–1673. Physician, St. Thomas's Hospital, London.

[2] Tuberculous cervical abscess is common in England. Between September, 1939 and October, 1945 I operated upon 686 of these cases; 200 of them had "collar stud" abscesses.

a possibility of a small incisional or other hernia through the anterior abdominal musculature must be excluded. In such circumstances I have noticed repeatedly that even candidates for higher qualifications omit to examine the patient standing up. Time and again, standing erect without other aid has brought to light a protrusion through the abdominal musculature (Fig. 9) that was indiscernible in the supine position.

Fig. 9.—Fatty hernia of linea alba that became visible when patient was examined standing up. He complained of symptoms that suggested presence of peptic ulcer.

The Differential Diagnosis Between Acute Appendicitis and Renal Colic.—Woe betide a patient with gangrenous appendicitis who passes blood in the urine! Until it is better known that an inflamed appendix lying in juxtaposition to the ureter (Fig. 10) can give rise to uteritis that causes hematuria, lives will be lost. When blood is found in the urine, the practitioner invariably rules out appendicitis, and not infrequently the consultant aids and abets him in treating the patient for "pyelitis." When a differential diagnosis between early acute appendicitis and renal colic is at stake, urgent excretory pyelography should be undertaken. If the pyelogram shows a normal outline of the right renal calyces and there is no evidence of a ureteric calculus, appendicectomy must be performed at once.

Fig. 10.—Inflamed appendix in contact with ureter is liable to give rise to ureteritis.

The Pons Asinorum[3] *of a Rectal Examination* is a cervix uteri, which can be felt projecting through the anterior rectal wall. Even after considerable experience, the inconstant size and shape of the os may, in a given case, cause momentary bewilderment. So great is the pitfall of the cervix that, in making a rectal examination in the female, it should be the rule to find the os deliberately first, and take bearings from that structure. Mistakes from this cause are then impossible.

The cervix uteri can be categorized as the undergraduate's "pons," but he shares a greater "asinorum" with the postgraduate. Many times I have observed the error; a typical example is as follows:

Four keen and industrious candidates for the Fellowship of the Royal College of Surgeons each digitally examined the rectum of a woman of 50 with abdominal pain and constipation. Two of them were satisfied that there was a growth in the ampulla of the rectum. Two of them looked puzzled; they considered that the growth was in the muscular wall of the rectum, or even outside it, and that it was rather smooth. On requesting one of them to follow up the examination by inserting a finger into the vagina (Fig. 11), all agreed that the term "pons asinorum" was not inapt.

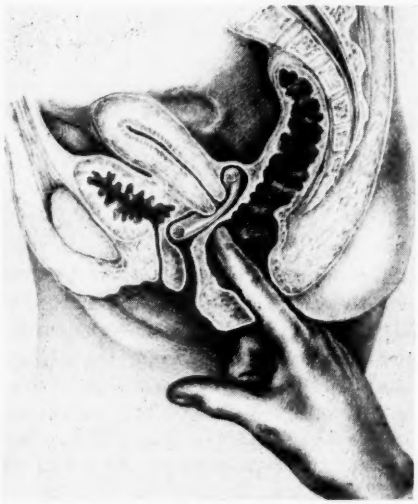

Fig. 11.—A ring or other vaginal pessary can cause diagnostic difficulties when performing rectal examination.

Strangulated Femoral Hernia.—An umbilical hernia can hardly be missed: a strangulated inguinal hernia is usually obvious: it is the small unobtrusive femoral hernia that is the stumbling block. It is not an exaggeration to state that never have six consecutive months of my surgical lifetime elapsed without my encountering at least one case of a small strangulated femoral hernia (frequently the Richter[4] type) being overlooked. The patient is usually an old lady. Occasionally the attending practitioner has seen and felt the lump, but has considered it to be an enlarged lymph node. Far more frequently, pandering to the false modesty of his patient brought up in the Victorian era,[5] he has failed to draw down the bedclothes far enough. The tell-tale lump is usually perfectly evident (Fig. 12). The omission to draw down the bedclothes can truly be designated as the chef d'oeuvre of acute abdominal diagnostic disasters.

Fig. 12.—When history suggests intestinal obstruction, abdomen should be uncovered from nipple line to apex of Scarpa's triangle. Only in this way will small strangulated hernias cease to be overlooked.

Enlarged Gland of Cloquet.[6]—[Cloquet's gland is the larger and most constant of the two lymphatic nodes that lie closely applied

[3] Pons asinorum, Lat., The Bridge of Asses. Euclid, Book 1, Proposition V.

[4] August Gottlieb Richter, 1742–1812, Surgeon, Göttingen, Germany.

[5] Queen Victoria, 1819–1901. During the 19th century, fashionable practitioners were wont to confine abdominal examination of the female to palpation beneath the bedclothes.

[6] Jules Germain Cloquet, 1790–1883, Professor of Anatomy and Surgery, Paris.

to the upper end of the femoral vein in the femoral canal (Fig. 13) and adjacent to that plug of fat known as the femoral septum.] As a regular source of diagnostic difficulty, enlargement of this lymph node is without rival; for this reason Cloquet's gland has gained for itself the reputation of being the most important lymph node in the body. It has earned its notorious character thus: When a patient has a strangulated femoral hernia containing omentum, the vermiform appendix, a diverticulum of the bladder, or, more disastrously still, when the hernia is of the Richter type, signs of intestinal obstruction are lacking. Often, indeed, there are no symptoms or signs other than purely local signs and insignificant symptoms—until it is too late even to attempt to rectify the consequences of an erroneous diagnosis that the swelling in question was due to lymphadenitis. In the event of an inflamed gland of Cloquet entering the clinical picture (nearly always the patient is a middle-aged or elderly woman), the first step is to ascertain whether there are other enlarged lymph nodes in the neighborhood, or in Scarpa's [7] triangle of the contralateral side. If there are, it suggests, but by no means confirms, that the swelling under consideration is an inflamed lymph node. In all cases a search must be made for a focus of infection, not omitting to look between the toes and at the back of the heel; the whole of the foot is inspected for a scab, boil or an infected scratch or blister. Likewise, the whole of the leg and the thigh, both back and front—not forgetting the crutch—is examined. Attention is then directed to inspecting the anus for inflamed hemorrhoids, or some other anal infected lesion. The search is concluded by separating the labia and looking for some infected focus of the pudenda that might account for lymphadenitis. We have now carried out efficient inspection of every area that has efferent lymphatic vessels connected with the deep femoral lymphatic chain. When this search proves fruitless, I am strongly of the opinion that the swelling should be explored.

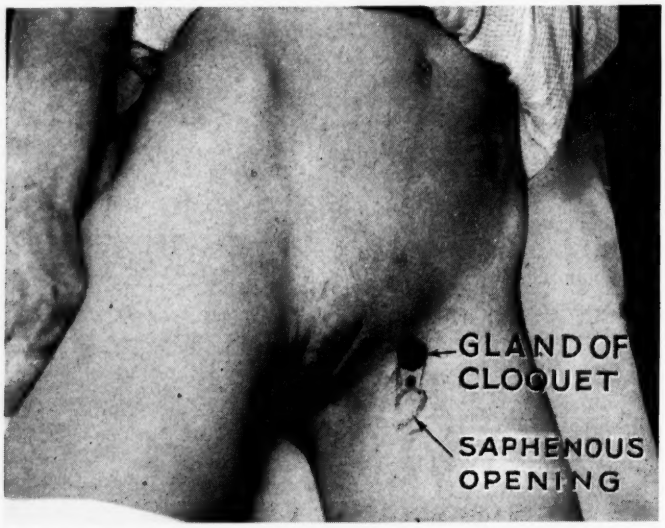

Fig. 13.—Gland of Cloquet—the lymph node of greatest surgical significance in the body.

A middle-aged woman developed a lump, which was diagnosed as "saphenous adenitis of unknown origin." Suppuration followed, and the abscess was opened. The next day the patient's condition rapidly became grave; she failed to respond

[7] Antonio Scarpa, 1752–1832, Professor of Surgery, Modena; Professor of Anatomy, Pavia.

to restorative remedies. Autopsy revealed diffuse peritonitis and a femoral hernia containing a gangrenous perforated diverticulum of the bladder (Werne and Garrow).

Lymphogranuloma Inguinale (Tropical Bubo).—Confronted with massive, painless adenitis of one or both groins that cannot be accounted for after carrying out the careful clinical investigation referred to in connection with the gland of Cloquet, one should reflect

Fig. 14.—Lymphogranuloma inguinale (tropical bubo). Infected lymph nodes in left groin are beginning to involve overlying skin.

that tens of thousands of the Armed Forces, now demobilized, have visited tropical and subtropical countries.

Lymphogranuloma inguinale (Fig. 14) is a venereal disease that in white people often causes considerable constitutional disturbance, and, unlike the usual manifestations in natives, the glands along the iliac vessels share the inflammation. The primary lesion is rather like herpes and is of fleeting duration (Stammers [8]). When lymphogranuloma inguinale enters the diagnostic arena, arrangements should be made for a Frei [9] intradermal test.

Tuberculosis of an Anteverted Testis.—However obese an individual, the skin of the scrotum contains no fat. For this reason I often remind myself, and sometimes openly remark, that he who is becoming puffed up with diagnostic pride should be confronted with a series of patients with testicular swellings. There, beneath the examining fingers, and separated only by little more than fat free integument, is a swelling that should prove diagnostic child's play to one who can elucidate the diagnosis of an intra-abdominal swelling. Why is it, then, that enlargements of the testis are among the worst diagnosed swellings to which the body of the male is heir? One of the reasons is clinical laziness. In the case of a testicular swelling, it is inapplicable to make a cursory examination and then pass the patient on to the x-ray department for elucidation of the diagnosis. Furthermore, except for the result of a Wassermann [10] reaction (which at times is most helpful), but little diagnostic aid can be derived from the pathologic laboratory. So it comes about that, when faced with the problem "what is this intrascrotal mass?", the clinician, as did his grandfather, must exercise to the full the five senses with which he is endowed. Instead of calling to his aid costly, complicated apparatus and highly skilled technicians replete with Bucky-Potter [11] diaphragm, a pocket torch and some shading from the brightness of the consulting room light is what is required. Here transillumination—efficient transillumination—is a diagnostic sheet-anchor; inefficient transillumination rivals omission of this cardinal method of examination as a source of testicular diagnostic blunders. Again, far more important than filling in a form requesting a leucocyte and erythrocyte count, a sedimentation rate, an acid phosphatase reaction and a gonadotrophic hormone content test, is painstaking, intelligent palpation, correlating the anatomic structures beneath the palpating fingers with a systematic plan running through one's brain. In this connection I wish to draw your attention to an excellent piece of clinical research undertaken by one of my former postgraduates. During the War, S. H. Waddy [12] examined 854 consecutive recruits with a view to ascertaining the relationship of the epidi-

[8] Francis Alan Roland Stammers, Contemporary, Professor of Surgery, University of Birmingham, England.
[9] Wilhelm Frei, Contemporary, formerly Professor of Dermatology, Berlin, now in New York City.

[10] August von Wassermann, 1866–1925, Director, Institute for Experimental Therapy, Berlin.
[11] Gustav Bucky, Contemporary, German Roentgenologist, in New York.
[12] Sidney Hill Waddy, Contemporary, Surgical Practitioner, Huddersfield, England.

dymis to the body of the testis.[13] In one out of every 13.77 normal men, the epididymis was not strictly in its usual position, viz., behind the body of the testis. In a high percentage of the aberrent examples the epididymis was in front and the body of the testis behind, instead of the body of the testis being in front and the epididymis behind. In other words, about one man in every 14 had an anteverted testis.

A few weeks ago I requested five advanced students to examine a patient whose diagnostic record (my findings) is shown in Figure 15.

Fig. 15.—Facsimile of diagram accompanying notes of case referred to in text.

Only one of the students, all of whom had ample time to examine the case thoroughly, arrived at the correct diagnosis. The remaining four had puzzled faces and hesitated to venture an opinion. They were suffering from absence of knowledge of that common anatomic anomaly, anteverted testis.

Ectopic Ureter.—Female patients with intractible incontinence sometimes harbor an ectopic ureter. On this occasion the diagnosis can nearly always be made from the history alone. Any girl or woman who has dribbled for as long as she can remember *despite the fact that she normally has desire to void, and does urinate,* has an ectopic ureteric orifice (Fig. 16), or orifices. If, after an intravenous injection of indigocarmine, the region of the vestibule is patiently scrutinized, the opening of the ectopic ureter is usually apparent.

A correct diagnosis of ectopic ureter will enable the clinician to effect a brilliant cure by an appropriate surgical procedure, usually a heminephrectomy.

[13] Testicle means, literally, "little testis." Testis is the better term.

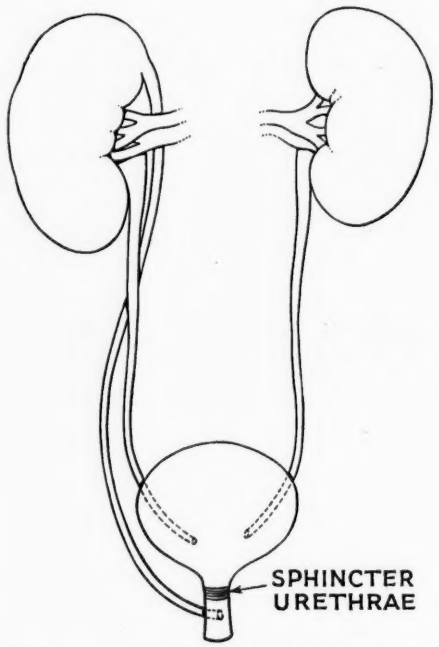

Fig. 16.—Ectopic ureter (Cristol and Greene).

Retention-with-Overflow.—The dome of an overfull bladder is usually rounded. In cases of long standing chronic urinary obstruction, i.e., retention-with-overflow (a condition in which the patient makes little or no complaint of pain or dysuria), the swelling arising out of the pelvis is wont to be mistaken for some other condition. This frequent error reaches its zenith when the contour of the dome of the bladder is unorthodox (Fig. 17). Not once,

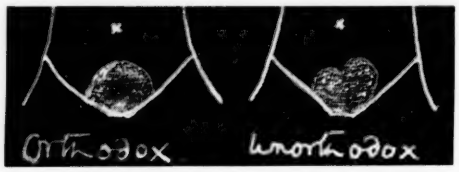

Fig. 17.—Blackboard sketch to show orthodox and unorthodox domes of overfull bladder.

but scores of times, I have seen clinicians beguiled by this phenomenon. For instance, the patient illustrated in Figure 18 came to my out-patient clinic bearing the following letter from an experienced practitioner: "Mr. C.

Fig. 18.—Retention-with-overflow. Note contour of dome of overfull bladder. Patient made no complaint of pain or difficulty of micturition.

has a large tumor filling up the hypogastrium and extending to the left. The remarkable thing is that he looks and feels well."

Hematuria, especially painless hematuria, is a signal that should stir the clinician to elucidate the cause. When, as is so usual, the bleeding proves transitory, sometimes, sad to relate, instead of receiving an appointment for a full urologic investigation, the patient is seen returning to his home carrying a bottle of medicine.

In the whole realm of clinical surgery the elucidation of the cause of hematuria stands unrivalled as an example where scientific methods (in this instance cystoscopy combined with roentgenology) have so bedwarfed physical signs as to render them puerile.

Clinical acumen is never superfluous; even in this instance intelligent, naked eye observation may come into its own; for instance, when beetroot is in season. The shade of red given by urine containing blood certainly varies very considerably, but it never resembles the peculiar purplish hue of "beeturia", if that term be allowed.

* * * * * * * *

A former Master of mine was wont to quote one of his Masters, whose name I have not remembered, for, in the days of my youth, I thought the quotation was rather silly: "Gentlemen, there are three principles in surgery; the first is diagnosis, the second is diagnosis, and the third is diagnosis."

With the passage of time I have come to regard this aphorism with greater respect.

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Intrapericardial Sarcoma

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This contribution to the "Jirasek volume" may be regarded as the expression of the author's admiration for the achievements of a great humanitarian and one of the most distinguished surgeons whose friendship has been a source of inspiration to me.

* * * * *

SURGICAL removal of tumors of the heart or the pericardium is obviously possible only in the absence of extensive infiltrations of the cardiac wall or the large cardiac vessels. The resection of a tumor limited to the auricular appendage of the heart, for instance, may be considered a possibility. Easily dissectable, benign tumors of the pericardium such as lipomata obviously offer no technical difficulty. However, it is different in large, solid benign neoplasms which have intimate, though detachable connections with the cardiac muscle, such as a case of teratoma of the pericardium, as reported by Claude L. Beck.*

Successful operation of a malignant tumor of the pericardium is even more dependent on extraordinarily favorable topographico-anatomic conditions.

The following case is interesting, because it appears to be the first one where extirpation of a malignant intrapericardial tumor was possible.

The patient, a 48 year old white male, noticed about 12 years ago a slow thickening of the end phalanges of his fingers, which, as time went on, became a very pronounced clubbing. During the last year the veins of his arms and legs became enlarged, and visible swelling of the ankles appeared. He lost some weight in the last months before operation, pains appeared in the left chest and occasionally he experienced shortness of breath and a feeling of pressure in the heart region during physical exertion. The color of his skin changed to a greyish blue. Feeling fatigued, he went to his doctor, who on fluoroscopy found a large mass in his left chest.

X-ray examination revealed the following (Fig. 1): A sharply defined ovoid area of increased density measuring about 17 cm. in its longitudinal, 11 cm. in its transverse and 11 cm. in its antero-posterior diameters, lying in the caudal half of the left mediastinum extending to the diaphragm. The left lower lobe appears to be atelectatic. The diaphragm is partially obscured. The costophrenic angles are obliterated. The right upper lobe and the entire right lung is markedly emphysematous. The right half of the diaphragm is low, but shows no other abnormalities. There are a few calcifications in the right hilar region. The heart is displaced to the right side but shows no other abnormalities. The aorta shows no abnormalities.

The proximity of this mass to the heart induced his attending physician to consult a cardiologist, Dr. D. Scherf. His findings were the following: A hyperactive heart with marked hypermotility, displaced slightly to the right; sounds pure; blood pressure 140/60. The electrocardiogram shows no evidence of myocardial lesion; low voltage is explained by the displacement. The ankle edema is not due to cardiac failure because the liver is normal; it is rather due to a tumor mass compressing the inferior vena cava, but not preventing the free flow of the portal blood from the hepatic vein.

There was agreement that an attempt of surgical removal should be undertaken.

When the patient was first seen by me, the impression was that of a solid tumor of the posterior mediastinum, probably a ganglioneuroma or fibroma. A benign growth seemed to be more probable than a malignant one, particularly in view of the long history. What could not be explained by a tumor of the lower mediastinum was the presence of a compression of the superior vena cava, as evidenced by the swelling of the arms and the associated dilatation of the veins.

An attempted needle biopsy failed. No tumor tissue could be aspirated through a heavy biopsy needle.

The patient was admitted to the Brooklyn Jewish Hospital, and the operation was performed under intratracheal cyclopropane anesthesia on Oct. 23, 1946.

With the patient in lateral position, the entire length of the left eighth rib was removed, and the

* Ann. Surg. 110:161–174, 1942.

thoracic cavity was entered through the bed of the eighth rib. Adhesions between tumor, chest wall and the lung made it advisable to enlarge the approach by transecting the seventh and ninth ribs in their paravertebral part. The tumor was partly covered by upper and lower lobes, these pulmonary segments being atelectatic. After dissection of numerous adhesions it became evident that the tumor was protruding into the interlobar space, its pedicle being firmly attached to the

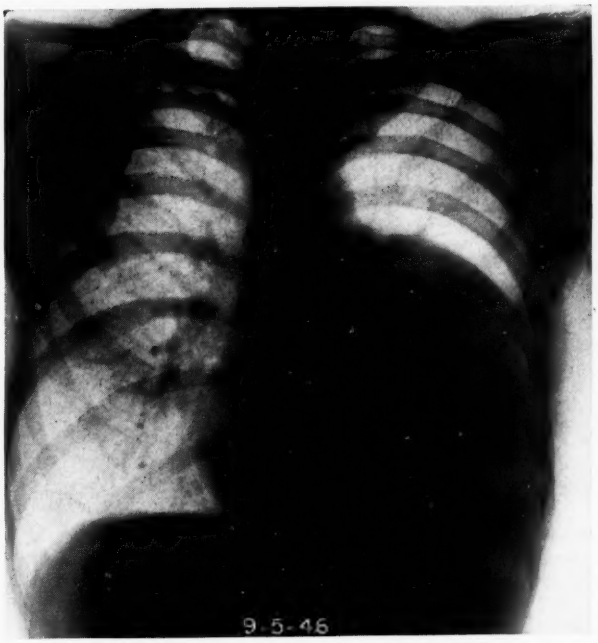

Fig. 1.—Roentgen appearance before operation.

Fig. 2.—Photograph of tumor. Arrow at intrapericardial part. Edges of excised pericardium are marked.

pericardium just below the point where the inferior pulmonary vein leaves the pericardium. The posterior mediastinum was free. There were some difficulties encountered in exposing the anterior surface of the pericardium, which was partly involved in the tumor mass. The phrenic nerve was crushed close to its entrance into the diaphragm. When the tumor was pulled upwards to visualize and dissect its pedicle, the action of the heart became irregular and the pulse extremely slow,

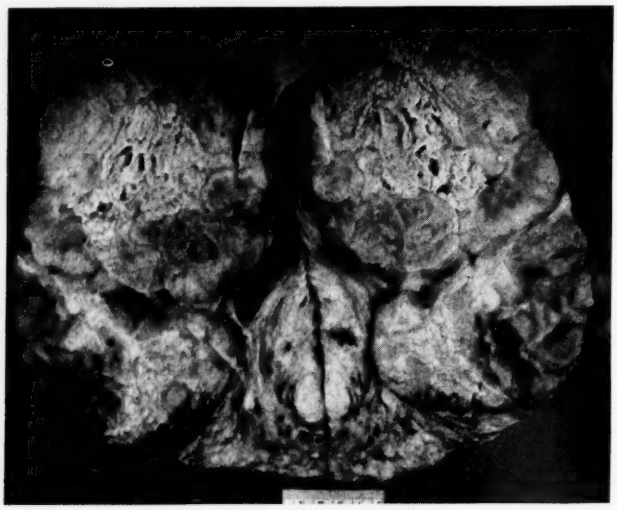

Fig. 3.—Cross-section of tumor.

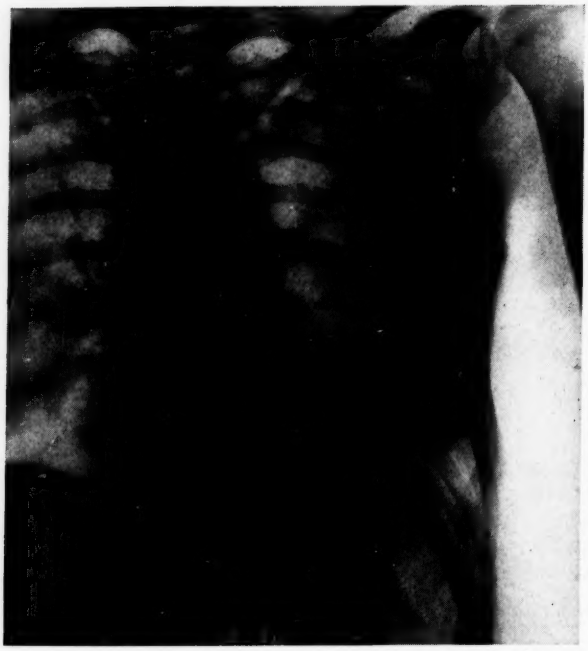

Fig. 4.—Roentgen appearance after operation.

but the respiration remained unchanged. This was explained by the fact that the heart followed the pull executed on the tumor; the heart almost appeared to be no more than an appendix to the large mass. In spite of the disturbances of the heart action, which reappeared every time the tumor was retracted, an attempt to expose the pedicle was made. The anatomic relation between tumor and heart was as follows: the pedicle was comparatively narrow, and it contained three large vessels which covered an extension of the tumor into the intrapericardial space. The pericardium itself was incised close to the mass. As soon as the dissection of the vessels had started, the heart stopped beating, and the blood pressure could not be obtained by the anesthetist. The respiration likewise became irregular; it was controlled by artificial and rhythmic expansion of the lung. Though the dissection of the pedicle was speeded up as much as possible, the heart action was disrupted for three to four minutes. That much time was necessary to place two pedicle clamps. Following this, the tumor was dissected off, and thereafter the pull on the heart was relieved. Consequently, massage of the heart was instituted and almost immediately the heart beats reappeared, first at a very slow rate, in a few minutes at almost normal rhythm and frequency. Suture ligatures (silk no. 1) were then placed around the clamps, each suture grasping the edge of an adjacent pericardial flap. This was done to fortify the ligatures which, as was our impression, went through the wall of the left auricle. Every time a suture was placed and tied, the heart action became irregular. The blood transfusion which was started at the beginning of the operation, was speeded up, and in a short time the general condition of the patient had again become satisfactory. The lungs were inflated and the chest wall incision was closed in five layers.

Ten hours after the operation the patient was still not reacting and respiration was slow, a condition considered to be a consequence of the long arrest of the heart (anemia of brain). However, after 24 hours he had regained full consciousness. From then on he had an uneventful recovery. There was a moderate hematoserothorax, but this never caused marked dyspnea. The oxygen tent was dispensed with on the fourth postoperative day. The patient got up for a short time on the tenth postoperative day, and stitches were removed on this day. He left the hospital on the seventeenth postoperative day. Since then he has gained 10 lb. Peripheral edema and dilatation of the peripheral veins have completely disappeared. He had to discard his shoes, because they had become too large. He is able to climb four flights of stairs to his apartment without dyspnea or palpitation. He feels stronger than ever before and has started his work about six weeks after the operation.

Although the gross appearance of the tumor, its well defined borders, absence of infiltrated lymph nodes and its long history suggested an innocent histologic nature, the result of the microscopic examination was somewhat surprising. Dr. Grayzel, pathologist of the Jewish Hospital of Brooklyn, gave the following report:

Gross: The specimen consists of a lobulated portion of tissue which measures 26×15×9 cm. and weighs 2,000 Gm. It varies from soft to moderately firm in consistency. External surface is pink white, blue grey, roughened by fibrous tissue tags, and on the capsule there are several firm elevated white areas measuring up to 0.3 cm. at the greatest diameter. On the cut surface it is lobulated. The lobules are separated by depressed areas of grey white tissue. The centers of two of the lobules are composed of yellow grey, necrotic tissue, surrounded by a grey white homogenous area. There is one firm nodule measuring 2.5 cm. at the greatest diameter which is white, homogenous and firm.

Accompanying the specimen are two portions of pink and grey osseous tissue measuring 19 and 5 cm. in length, apparently portions of ribs.

Microscopic: Preparations from various portions of the tumor give a somewhat variegated picture. The more cellular portions consist of spindle-shaped cells in interlacing bundles. The cells vary slightly in size, and in some the nuclei are hyperchromatic. An occasional mitotic figure is seen. Elsewhere there are dense bands of collagenous fibrous tissue traversing the tumor. In some areas small and large round cells are also present. The tissue is edematous and loose throughout, and the vessels appear engorged. No striations can be made out with the P.T.A. stain. The L.C.T. and V.G. stains show many dense collagen bands.

Diagnosis: Fibrosarcoma of heart.

Findings at the operation did not satisfactorily clear up the question of whether the tumor originated from the epicardium or the pericardium. The fact that the pedicle of the tumor was related to the wall of the left auricle is consistent with either of these possibilities: (1) that the tumor originated from the epicardium; (2) that it secondarily infiltrated into the epicardium. The presence of vessels in the pedicle of the tumor origi-

(Continued on page 597)

Treatment of Fractures of the Ankle Joint*

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ANY discussion of the proper management of ankle fractures cannot too often be reiterated, since results in the more severe types are frequently not satisfactory. The residual degree of disability can be very severe. Malunited fractures present problems to tax the skill and the ingenuity of the surgeon, who should, therefore, be equipped with essential knowledge, skill and experience before attempting treatment.

First, he should possess a thorough knowledge of the anatomy and kinesiology of the ankle joint; second, an understanding of the types of fractures and fracture dislocations with their causes and effects. Proper interpretation of physical and x-ray findings is necessary in order to plan and execute proper treatment, including manipulative, plaster and surgical procedures.

Considering the fact that the ankle is a weight-bearing joint, even minor disturbances of the articular surfaces can result in disturbances of function which become persistent, painful and will result in traumatic arthritic changes.

Ashhurst and Broner in 1922 classified and outlined the mechanism of fractures of the ankle. They described the following fracture types: first, external rotation and abduction; second, adduction; third, vertical compression. They report in their series of cases 61 per cent of the first type, 21 per cent of the second and 1.7 per cent of the third. Thus it is apparent that the classification affords a more thorough understanding of the mechanism and the resulting pathology of ankle fractures, and it avoids the tendency to consider all such injuries as of the Pott or Dupuytren type.

At initial clinical and x-ray examination, the surgeon can easily determine the mechanism by which the fracture was produced. It is necessary then to reverse this process in accomplishing reduction. For instance, a typical Pott's or abduction fracture is produced in the following way. First, the foot is suddenly twisted into eversion. This drives

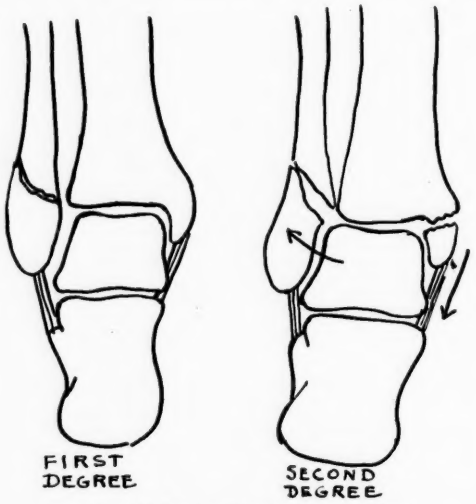

Fig. 1.—Abduction fracture mechanism.

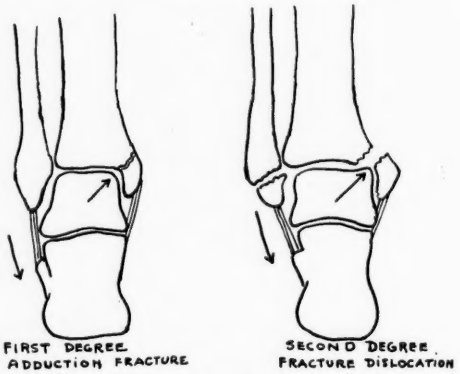

Fig. 2.

* Read before the Eleventh National Assembly, United States Chapter, International College of Surgeons, Detroit, Michigan, October, 1946.
† From the Department of Surgery, George Washington University Medical School, Washington, D. C.

the talus against the fibula causing it to fracture, usually at the level where the malleolus meets the narrowing portion of the shaft. With continuing force the fibula then gives way. A tractive force continues to produce rupture of the medial collateral ligament or produces a fracture of the medial malleolus and widening and distortion of the ankle mortise. Therefore, a tractive force is required to reduce the displaced foot when the foot is posterior and lateral and the tibia forward and medial. Where the severity of the ligamentous avulsion renders maintenance of position difficult, a wire inserted through the calcaneus is sometimes necessary.

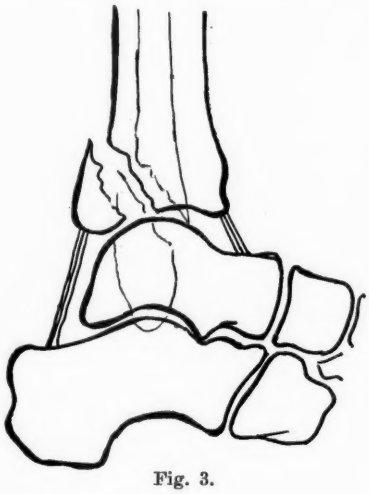

Fig. 3.

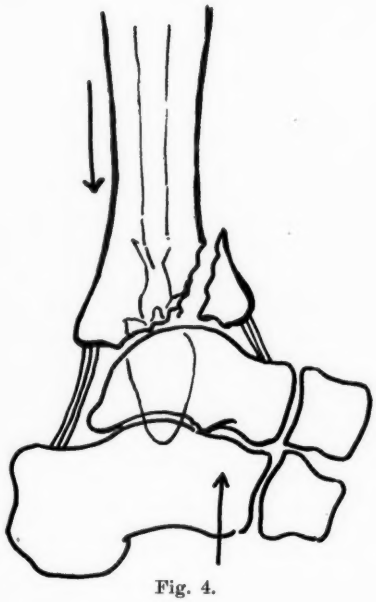

Fig. 4.

If a severe lesion is obviously present before swelling has become marked, then a reduction should be done and an unpadded cast applied. Later x-ray examination will determine whether further procedures are indicated. The patient should be told of those conditions which may require further manipulation or operative procedure. A temporary cast can be applied to prevent further swelling from additional movements or handling of the damaged tissues; when the swelling has subsided, a delayed reduction or further manipulation can be done.

Considering the experiences with reduction and plaster application, we wish to detail here the following methods which have proved of value.

First, the position of the patient on the table is of importance to aid in ease of reduction and control of the molding of the ankle in plaster. The position allows for complete relaxation of leg, ankle and foot, and the manipulation done by the surgeon seated opposite the foot renders the final position easy to maintain by the assistant holding the foot, and eases the application of the cast which, as it hardens, can be molded by the surgeon's hands on either side of the ankle and the pressure further aided by the pressure of the surgeon's thighs. In severe types of fracture dislocations, the cast should extend above the flexed knee. The operator must have enough confidence in his plaster technic to be able to apply the necessary pressure through the cast while molding the fragments into position without fear of pressure sores. He must be able to apply and maintain a completely snug cast from reduction to healing. Loose casts are frequently the cause of bad results. It is not necessary to force the foot into extreme varus, but it is best to keep the foot at a right angle and in midposition to maintain the normal weight-bearing line extending from the midpatellar line to a point between the first and second

Fig. 5 *(left)*.—Severe trimalleolar abduction injury.

Fig. 6 *(right)*.—Type of reduction after malleolar molding.

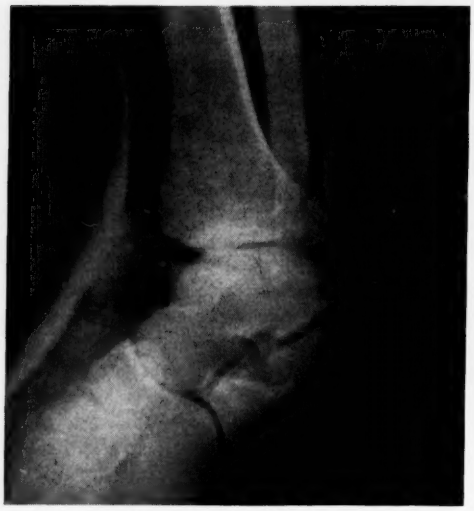

Fig. 7.—Incomplete reduction requiring screw fixation.

Fig. 8.—Same case as preceding, after operation.

Fig. 9 *(left)*.—Widely separated (bimalleolar) ankle mortise.
Fig. 10 *(right)*.—Same case, after molding.

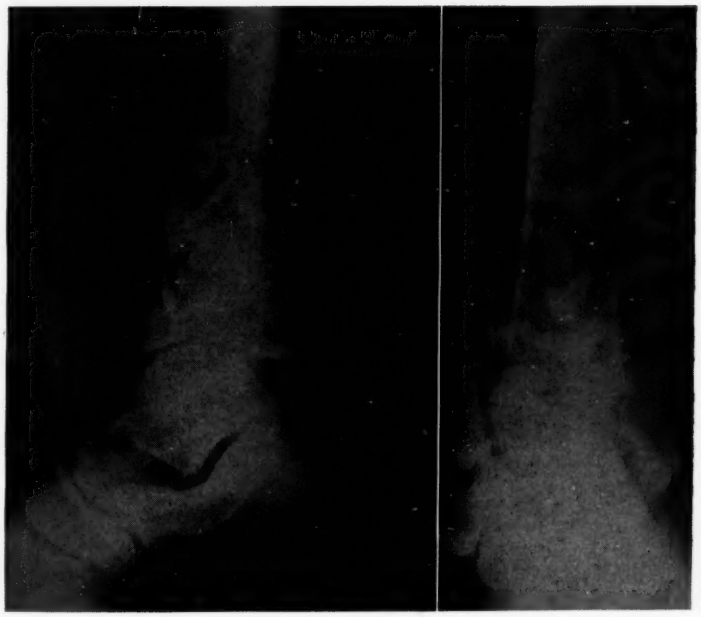

Fig. 11.—Severe, comminuted, vertical adduction type, requiring ankle fusion.

toes. Temporary elevation for several days aids to reduce soft tissue swelling. In 10 days or two weeks, the first cast is removed and a second snug cast applied with the same careful molding about the malleoli and, in most cases, a cast below the knee only.

In severe types, no weight bearing is allowed for at least eight weeks. If satisfactory position has been maintained, the cast can then be split. Physiotherapy is then started to restore circulatory and muscular tone and joint function before weight bearing is begun, but only after sound healing has taken place as judged by x-ray examination and careful analysis of the integrity of the all important ligamentous healing.

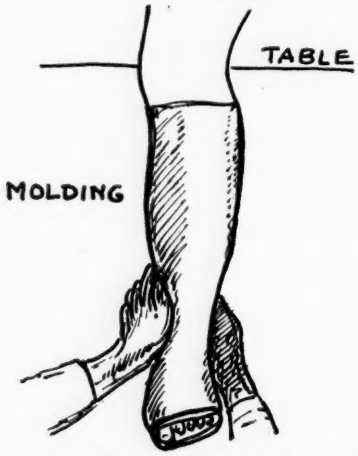

Fig. 12.—Method of molding as plaster sets.

Walking casts before healing in cases showing any evidence of diastasis or malleolar separation are not used for fear of either further separation or loss of complete reduction.

In cases of separation of the medial malleolus where unsuccessful reduction occurred, the surgeon must plan an operative repair and fixation by pin, graft or vitallium screw. The cause is usually a curtain of soft tissue which has become displaced between the fragments. During the recent World War, as in civilian cases, it was found that a delayed, incomplete or fibrous union of this fragment constituted a serious delay in restoration of painless function. In older cases, a bone graft should be done, as the separated fragment has little osteogenic possibilities.

In cases where malposition of the ankle mortise persists, it is inevitable that chronic and severe traumatic arthritis will develop with its attendant greater degree of disability. We wish to stress the necessity for ankle fusion in such cases. This procedure results in quite satisfactory gait and excellent stability and elimination of severe pain and local symptoms. Such cases of severe compression, involving the articular surface or the plafond surface of the talus, should be fused to give satisfactory termination of an otherwise severely crippling condition. It is folly to make repeated attempts at reduction of a severely comminuted fracture dislocation, when it is seen that the articular damage precludes a satisfactory repair for the gliding surfaces so necessary for normal sustained use.

SUMMARY

The surgeon should understand the type and mechanism of ankle fracture and dislocation.

2. More careful attention must be given to the accurate reduction and the proper cast technics. Surgical interventions can be used in certain types of cases for better results.

3. Care must be taken not to allow too early weight bearing, and adequate follow-up is most necessary.

4. Ankle fusion should be used more often when it is obvious that painful function and disability due to arthrosis deformans will be the result of severe joint damage.

SOMMAIRE

1. Le chirurgien devrait connaître la nature et le mechanisme des fractures et des dislocations de la cheville.

2. Il importe de faire une réduction exacte de la difformité et d'appliquer soigneusement les attelles immobilisatrices. Dans certains cas, il est nécessaire d'intervenir chirurgicalement.

3. On ne permettra pas le maladi de mettre prématurément aucun poids sur l'extrémité lésée.

4. La fusion de l'articulation indiquée dans

les cas où la jointure a été sérieusement endommagée et aussi dans les cas où la douleur et l'invalidisme sont exagérés.

SUMARIO

1. En el tratamiento de las fracturas de la region de la garganta del pie es importante que el cirujano este bien familiarizado con los mecanismos de produccion de dichas fracturas y las dislocaciones co-existentes.

2. Se debe de prestar bastante atencion en la reduccion de las fracturas y en la aplicacion de las vendas enyesadas. En ciertos casos es mejor el utilisar la cirugia operatoria.

3. Se debe de evitar el uso muy temprano del pie, y muy especialmentes en la locomocion.

4. En los casos de traumatismos serios que evidencian una desabilidad permanente por la artrosis deformante se debe de recurrir a la artrodesia.

SOMMARIO

1. Il chirurgo dovra capire il tipo e meccanismo di frattura e dislocazione alla noce del piede.

2. Piu accurata attenzione deve essere data alla accurata riduzione e di propizia gettata tecnica. Le intervenzioni chirurgiche potranno essere usate in certi tipi di casi per migliori risultati.

3. Cura deve essere presa per non permettere troppo presto presante contegno, ad adequata osservazione e il piu necessario.

4. La fusione alla noce del piede deve essere usata piu spesso quando e evidente che funsione dolorosa e disabilita causata da difformita all' artrosi sara il risultato di severo danno all' articolazione.

Свод

1. Хирург должен понимать тип и механизм переломов и вывихов ступо-голенного сустава.

2. Необходимо обращать больше внимания на аккуратное вправление и правильную гипсовую технику. Для лучших результатов в некоторых случаях можно применить хирургическое вмешательство.

3. Необходимо предотвратить слишком раннюю нагрузку и очень важно проследить прогресс.

4. Когда ясно, что болезненная и уменьшенная функция, причиненная **arthrosis deformans**, будет результатом сильного суставного повреждения, то советуется более частое применение слияния состава.

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INTRAPERICARDIAL SARCOMA

(Continued from page 591)

nating directly below the exit of the inferior pulmonal vein speaks more in favor of the first hypothesis (epicardium).

The tumor in this case had the mechanical effect of an intrapericardial effusion under high tension. There can be no doubt that this compression of the heart would have become fatal with the passing of time and its increasing size.

SUMMARY

The author reports a case of intrapericardial sarcoma with successful removal of the malignancy and survival of the patient.

SOMMAIRE

L'auteur rapporte une cas de sarcome intrapéricardiaque. Il enleva la tumeur complètement. Le malade guérit.

SOMMARIO

L' autore rapporta un caso di dentropericardiale sarcoma con successo di rimazione della parte malignosa e la recuperazione dell' infermo.

Свод

Автор докладывает случай интраперикардиальной саркомы с успешным удалением злокачественной опухоли и выживанием больного.

An Original Operation for Decubital Ulcers*

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ONE of the more profitable incidents of World War II was the realization that the decubital ulcer in cases of transverse myelitis is amenable to operative ablation. The problem became an acute one early in 1945, with the sudden arrival of a large number of overseas cases afflicted with decubital ulcers, most of which were confined to the neurosurgical and plastic centers in the several commands. The solution of this problem met with certain difficulties because of the age-old defeatist attitude that these lesions were regrettable complications in cases usually terminating in death.[13]

In the 20 years preceding this period, very few papers of any surgical merit appeared dealing with this condition. These advanced the problem above surgical negation and the attitude that it was essentially a nursing responsibility. The meager literature nevertheless showed the issue to be surgically manageable beyond mere cauterization, escharring with tannic acid and free grafting. Free skin grafting of these ulcers was known for a long time to be inadequate, except as a biologic dressing which would stand little wear and tear with bone as its background.

John Staige Davis,[1] in January, 1938, reported on two cases of successful closure of "scars following bed sores," by the in-shifting of French flaps after excision of the scar tissue. This procedure time and trial showed, though fairly successful in ulcers associated with orthopedic conditions, was not adequate in transverse myelitis. Crose, Schullinger and Shearer,[2] in January, 1946, reported on a three months' successful flap closure of eight cases of ulcer in transverse myelitis. Donald Munro,[3–7] in September, 1940, was one of the first of modern authors who thought he recognized a difference in the pathologic physiology attendant upon ulcers in transverse myelitis as contrasted with ordinary bed sores.

The simple in-shifting of collateral flaps over the area after excision of the ulcer had been employed by me in 1944, in seven cases of decubital ulcer. Careful observation made it evident that the method was not entirely adequate in cases of cord lesion. The outstanding feature in the inadequacy of the French flap seemed to be that even in cases where primary healing did occur, sooner or later after weight bearing a certain degree of subcutaneous fatty necrosis took place, at times resulting in discharge or absorption of the liquefied fatty tissue leading to adhesions of the overlying skin to the underlying bone and so to final breakdown terminating in reulceration. Interpretation of this phenomenon attended by liquefaction of the subcutaneous fat seemed important. It led to the inference that consistent and permanent ablation of decubital ulcers in transverse myelitis was not entirely dependable by the exclusive use of the French flap per se, because the method as such violated a principle of reconstructive surgery and omitted consideration of a basic biologic proposition. The surgical principle involved is that nature normally does not permit intimate contiguity of fat and bone without interposition of another tissue, usually in the form of a bursa, to cushion the subcutaneous fat against trauma from the underlying bone. Where such contiguity is the result of surgical intervention, the more vulnerable of the two tissues, in this case the fat,, will suffer replacement by fibrous tissue or ablation by fatty necrosis. The biologic proposition violated by the conventional flap repair resides in the fact that bare bone is an inadequate physiologic bed for the survival of any tissues as complex and as easily traumatized as fat; particularly is this true where the tissues are for one or another reason physiologically subnormal.

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* Presented before the Chicago Surgical Society, Mar. 7, 1947.
† I wish to express my gratitude to Dr. Joseph Kostecki (formerly, Captain M.C., A.U.S.) for his collaboration in the initial stage of development of this work, originally started at Northington General Hospital, Plastic Center 4th S.C., A.U.S.

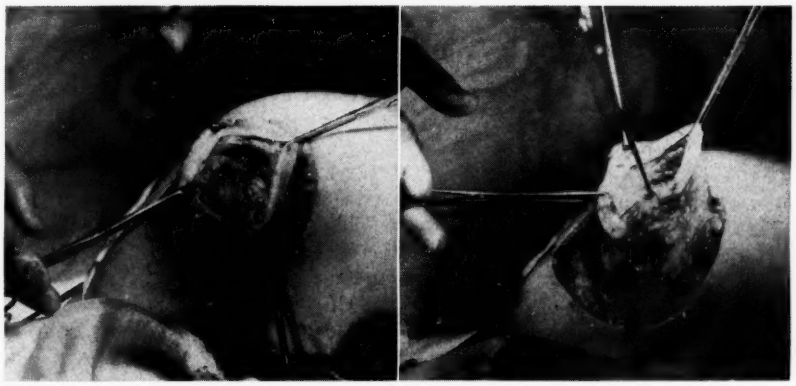

Fig. 1 *A (left).*—Decubital ulcer is circumincised through healthy skin to a depth of one-half the thickness of subcutaneous tissue. Fig. 1 *B (right).*—Entire extent of the decubitus is avulsed through the subcutaneous fat, except base of ulcer which is left attached in situ.

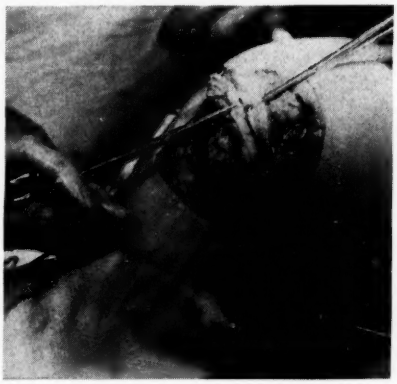

Fig. 1 *C.*—Ulcer rim brought to center to estimate amount of epithelial rim which can be sacrificed. Remaining sides of ulcer to form roof of surgical "bursa."

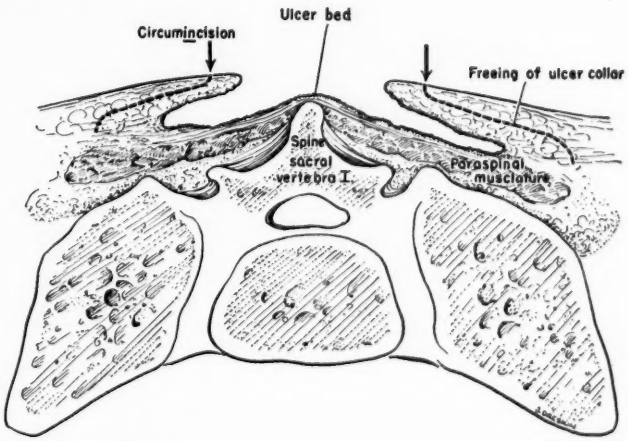

Fig. 1 *D.*—Placement and direction of circumincision, with separation of subcutaneous fatty tissue as shown by dotted line. This mobilizes ulcer collar which will make roof of future surgical bursa.

It is readily admitted that following transection of the cord the skin becomes anesthetic and the muscle paralyzed. It would seem unreasonable to suppose that the subcutaneous tissue remains unscathed; in fact, close observation of the fatty tissue at time of operation elicits certain gross abnormal findings usually overlooked, such as spotty discoloration, increased friability and very marked oozing. Robert H. Kennedy [8] observed this when dealing with 67 patients with spinal cord injuries; 12 patients presented complete sympathectomy effects. Notwithstanding the fact that Brown Sequard in 1853 attempted by certain classic observations to reconcile ordinary bed sores and decubital ulcers associated with transverse myelitis as being identical from the standpoint of their pathologic physiology, there remains a question as to whether his work on guinea pigs can so easily be applied to human beings in the face of what modern physiology teaches concerning the nature of "spinal shock" in man and certain lower animals. In man the condition "spinal shock" may persist for weeks, whereas in lower animals it manifests itself for only several hours to a few days. This does not, on the other hand, prove Charcot's thesis that "the existence of certain

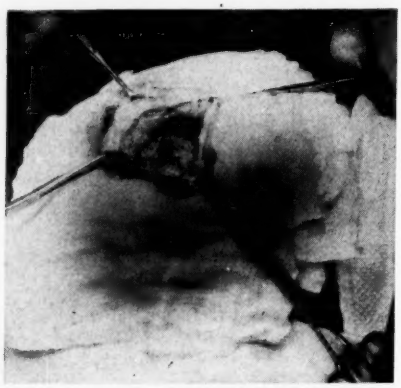

Fig. 2.—Avulsed ulcer draped for circumcision. Note undisturbed base of ulcer still attached to original site.

Fig. 3 *A (left)*.—Beginning of circumcision. Note retained depth of ulcer wall, supported by vertical forceps. Fig. 3 *B (right)*.—Circumcision of ulcer all but completed.

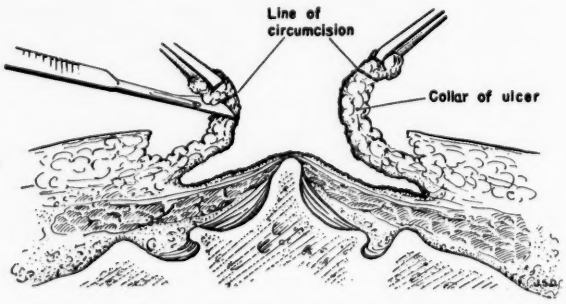

Fig. 3 *C*.—Line of circumcision in sagittal section. This removes undesirable curled-in epithelial rim of original ulcer and creates fresh edge on ulcer collar. The latter is illustrated in its mobilized position.

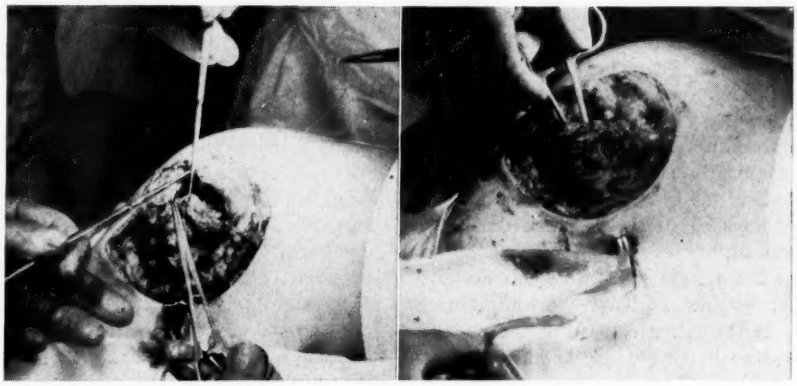

Fig. 4 *A (left).*—Sides of ulcer now being sutured together to form roof over undisturbed base of lesion, thus creating closed pouch or "bursa." Note amount of fatty tissue left on turned-in walls of ulcer. Fig. 4 *B (right).*—Just before final imbrication of roof of "bursa," a button hole is made from within ulcer pouch to outside through good skin and a gutta-percha drain inserted. Final closure of "bursa" is then executed.

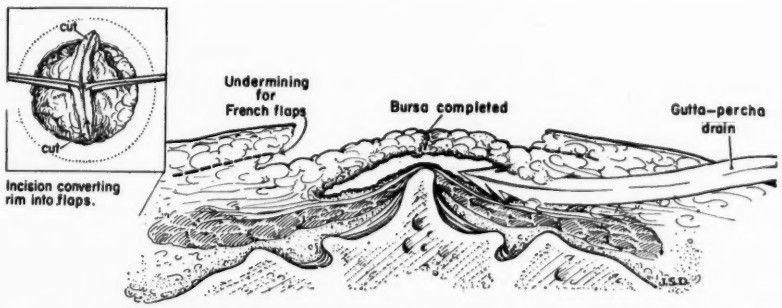

Fig. 4 *C.*—Apposition of edges of ulcer collar to form roof of bursa. Note exit of gutta-percha drain through healthy skin. Dotted lines indicate undermining of skin and subcutaneous tissue to form French flaps which complete closure of surgical defect.
Insert.—Trial apposition of ulcer collar to test adequate mobilization thereof in creation of roof for bursa. Dotted lines at 6 and 12 o'clock indicate splitting of ulcer rim to form flaps.

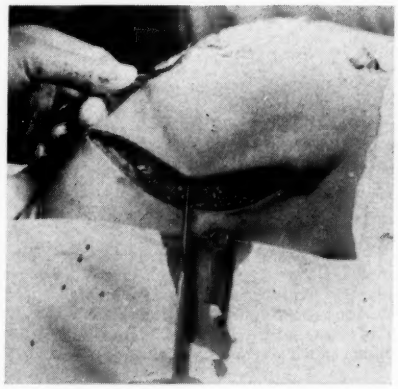

Fig. 5 *A.*—French flap is designed, as permitted by circumstance (in above case by hemisection of gluteal skin and subcutaneous fat), to cover surgical "bursa." Flaps should be so calculated as to avoid suture line over "bursa," and if possible outside a weight-bearing surface. Note cigaret drain outside contemplated closure and suture line.

trophic centers governing nutrition damage, which results in neurotic necrosis when aided by local pressure,'' can be taken literally. The fact remains that Charcot's conclusions stem, for the most part, from his observations and work with human subjects. None of the older investigators, including the contemporary Donald Munro, who believes that ''It may safely be said under normal conditions an adequate supply of blood to the skin depends upon the integrity of two reflex actions, which must include at least the spinal cord . . . failure of the reflex control of the cutaneous circulation when added to the local changes that have produced or will produce a pressure sore, causes a bed sore to develop on this site''; none of these investigators have paid sufficient attention to the timbre of the subcutaneous tissue and the influence of the condition of its circulation upon that of the skin.

It becomes evident to anyone who has handled a large series of these cases, that certain obvious clinical differences do exist between ordinary pressure sores and decubital ulcers occurring in spinal cord injuries. The ulcers frequently appear with little warning early in the disease and spread radially, essentially by subcutaneous fatty necrosis and undermining of the skin. There is much less tendency toward coincident granulation as compared with ordinary pressure sores. They have a tendency to become stationary and spread again in spite of improvement in the general condition. The interdependency of the serum protein level and the presence of open wounds may at times confuse the picture so that cause and effect are misinterpreted. In connection with the latter, Munro goes on to say, ''Based on our knowledge of the deleterious effect of spinal shock on all reflex activity below the level of any spinal cord injury, its presence immediately after the injury and its characteristic continuation or recurrence whenever exhaustion or sepsis develops, I have assumed that the difference between ordinary pressure sore and the bed sore associated with any injury to the spinal cord exists because of the influence of spinal shock on the peripheral vasomotor reflexes. An analogy is found in the effects of spinal shock on the bladder, the mechanism of which is not well established. Reasoning from this analogy as well as from theoretical grounds, backed by such knowledge of the vasomotor reflexes as is possessed, bed sores should be especially common in thoracic cord and upper lumbar cord lesions; that is, with the bone injury between the first dorsal and the first lumbar vertebra. It is here that the central connections of the sympathetic nervous system are made. As will be seen, my experience bears out this theory.''

Extensive experience with decubital ulcers in transverse myelitis brings to light other clinical facts. Try as one may to control these lesions by general measures,[10] only the very small ones may heal through maintenance of protein levels and the very large ones may even become temporarily stationary; yet only with the improvement of the spinal condition is there definite resuscitation of the

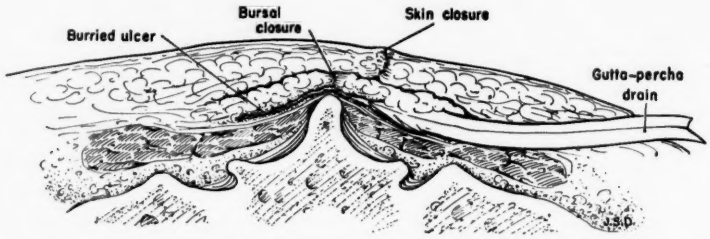

Fig. 5 *B.*—Apposition of lateral skin flaps over surgical bursa with skin closure completed. Note collapse of bursa, adequate tissue padding, and that skin closure is designed to fall to one side of midline, thus shifting it from weight-bearing surface and avoiding superimposition of two suture lines. This is accomplished by projecting secondary undermining much farther to one side than the other.

local tissue timbre and definite signs of healing by scar formation.

The entire premise underlying comprehension of the nature of the decubital ulcer in transverse myelitis may be stated succinctly as follows: a tissue physiologically hurt, as the skin and subcutaneous fat appear to be in transverse myelitis, probably due to neuro-

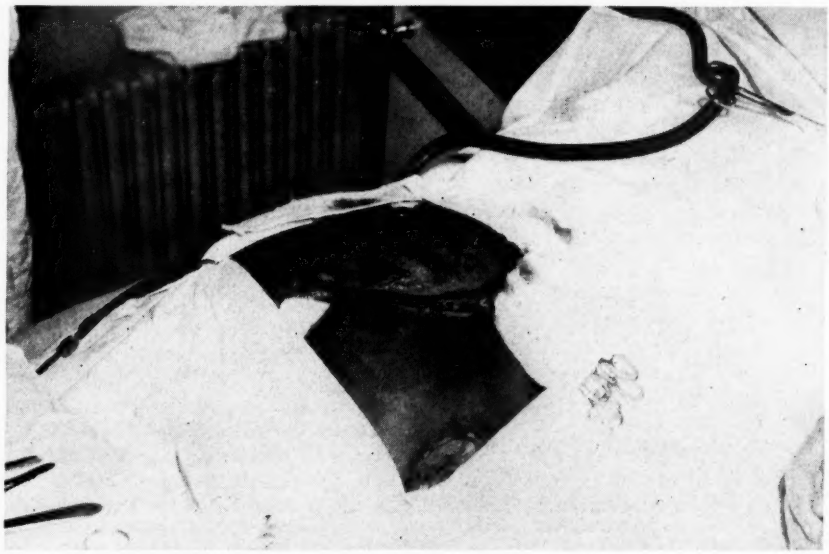

Fig. 6 *A*.—Patient who is emaciated with decubital ulcer of consistency too thin and friable for dependable mobilization. This type of ulcer is more dependably managed by lining it with split free graft before creating bursa.

Fig. 6 *B*.—Same patient. Decubital ulcer three weeks after grafting. Donor site illustrated, by light area across back of patient. Case is now ready for author's method.

circulatory disturbance, cannot be exposed to additional physical trauma unavoidable in the unphysiologic apposition of the raw fat of French flaps against the rigid underlying bone, without eventual loss of that tissue through functional trauma consequent upon weight bearing, unless special precautions are taken to safeguard the integrity of the subcutaneous fat. If, then, the subcutaneous tissue of the French flap can be protected from the underlying spine or trochanter, as the case may be, by tissue more kindly to it, a more permanent functional result should accrue.

The following procedure was therefore devised. It applies to ulcers with an intact base, where underlying bone is not presenting, infected or necessitating removal.

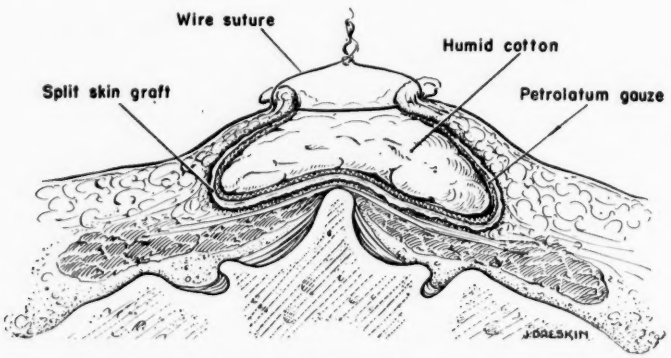

Fig. 6 *C.*—Method of application of split skin graft to interior of decubital ulcer, also dressing thereof by layer of petrolatum gauze and humid cotton pack. Edges of ulcer are then lightly pulled centripetally by required number of fine stainless steel sutures.

This situation is maintained for 8–10 days; then humid cotton and petrolatum gauze are removed and grafted ulcer cleaned of all debris. A dry cotton pack is reinserted under wire sutures for 4–5 days. Sutures and pack are then removed, grafted ulcer cleansed and patient prepared for author's procedure, 8–10 days later.

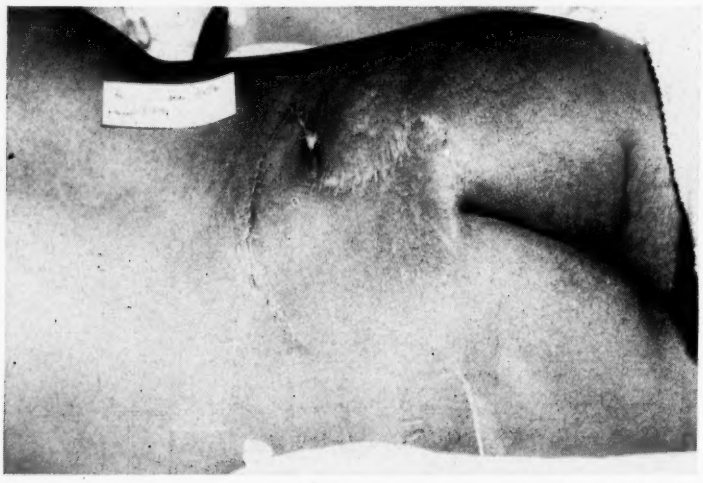

Fig. 6 *D.*—Same patient. Completed case following author's method—five months postoperatively and 133 days after patient has been consistently lying on his back.

TECHNIC

The ulcer is circumincised through healthy skin to a depth of one-half the thickness of the subcutaneous fat (Fig. 1). By gentle separation the deeper one half of the subcutaneous fatty layer is left upon the already undermined circumference of the ulcer. When the extreme periphery of the ulcer is reached, the circumference of the defect can be lifted, then pulled centrally in the form of a roof, thus forming a tissue pouch. The base of the ulcer is left undisturbed and attached to the underlying bone (Fig. 2).

The abnormal epithelial rim of the tissue pouch is then excised, leaving a clean edge of granulation tissue, fascia and fat (Fig. 3). The rim is split at 6 and 12 o'clock or at 3 and 9 o'clock, depending upon the polarity of the ulcer. This results in two flaps (Fig. 4).

The granulation tissue of the ulcer is then swabbed with phenol or tincture of iodine, the flaps sutured together and imbricated, thus forming a kind of bursa of granulation tissue, covered by a layer of subcutaneous fat. Drainage is then instituted (Fig. 4). The bursa probably becomes obliterated by fibrous tissue. In the meantime, it subserves an important physiologic function.

The logic of superimposing flaps over the surgical bursa covered by fat, *thus burying the lesion instead of excising it*, becomes biologically suitable and physiologically tenable. The actual designing of the French flaps must be dictated by the conditions peculiar to each case (Fig. 5).

Where the patient is emaciated, subcutaneous tissue is at a premium, the ulcer too friable, or bone presents, the lesion is first free grafted, after removal of protruding bone (Fig. 6). After healing takes place, the operation proceeds in the manner described, except that only a film of fatty tissue need be left on the collar of the reinforced ulcer. This proves sufficient protection for the subcutaneous fat of the French flap against the trauma of the underlying bone. The epithelial lined bursa may persist indefinitely, thus subserving an important function.

Because these patients are bedded ventral side down, one of the most difficult factors in the maintenance of the repair is control of the pull of gravity upon the suture lines of the paralyzed hip girdle. To exaggerate the importance of this detail from the standpoint of final healing is difficult. Consequently, the buttocks in these cases must be forcibly splinted in an exaggerated dorsal position for two to three weeks. The inclusion of all other adequate postoperative necessities of management must be allowed.

This report is based upon 39 cases which were rechecked after a lapse of 6–22 months. It involves the repair of 58 separate lesions, consisting of 31 cases of transverse myelitis and 8 orthopedic cases. All but 2 of the lesions have stood up under stress and strain of use up to 22 months. The exceptions, 2 partial breakdowns, were definitely due to the pull of gravity upon the buttocks.

The essential aim of these remarks is to point out the necessity of a biophysiologic rather than a simple physical approach to the problems of surgical repair of decubital ulcers consequent upon transverse myelitis.

It is hoped that this may stimulate further research in the understanding of adequate ablation of these lesions.

SUMMARY

The author points out the differences between decubital ulcer and the ordinary bed sore and deplores the defeatist attitude that cubital ulcer is a regrettable complication in cases usually terminating in death. He reports an original technic applicable to ulcers with an intact base, where underlying bone is not presenting, infected or necessitating removal. One important point in the technic is the necessity for exaggerated dorsal splinting of the buttocks to prevent lack of healing by the pull of gravity on the suture lines of the paralyzed hip girdle.

SOMMAIRE

L'auteur indique les différences qui existent entre les ulcères "decubitus" et l'ulcère ordinaire, dû à la compression prolongée du séjour au lit. Ces ulcères sont quérissables; negliges, ils sont ordinairement fatals. Il indique une technique qui donne d'excellents résultats dans les cas où l'ulcère a une base intacte, c'est à dire, quand l'os ne présente pas, n'est pas infecté et qu'il n'est pas nécessaire de l'enlever. Il importe de bien immobiliser les fesses afin qu'il n'y aît aucune tension sur les lignes de suture de la ceinture de la hanche paralysée.

SOMMARIO

L' autore addita la differenza tra ulcera decubitale e la ordinaria piaga di letto e deplora l' attitudine difettista che l' ulcera

(Continued on page 610)

Partial Colectomy with Partial Hepatectomy

Carcinoma of the Splenic Flexure with Solitary Liver Metastasis

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TODAY the presence of metastases is considered a surgical challenge rather than a sign of inoperability. This particularly applies to solitary metastases which might also be excised if the primary growth and the surrounding tissues to which it has extended have been resected. Operations performed for the removal of metastatic lesions are justifiable, since there is some chance for success, and failure to remove the lesion results in death. These procedures have a definite value, if for no other reason than the palliative effects brought about by the removal of secondary growths. This fact is substantiated by Barney and Churchill's [1, 2] report of a patient who is alive and well 12 years after removal of a metastatic lesion. Wangensteen [3] states that because of the length of survival of many patients undergoing primary resection of the colon for cancer, with hepatic metastases at the time of operation, resection of such metastases seemed worth while. Alexander and Haight [4] reported on 24 cases of solitary metastatic carcinomas and sarcomas to the lung which were resected; some of the results are most encouraging. Brunschwig [5] states that solitary metastases which are readily accessible might be excised if the primary growth is also eradicated.

After an extensive search of the literature, I am impressed with a marked paucity of reports dealing with the removal of portions of the liver for metastatic lesions. The first report of the removal of a metastatic carcinomatous nodule of the right lobe of the liver was made by Garré [6] in 1888. He excised the mass with a scalpel and seared the cut surface of liver with thermocautery. The point of origin of the primary tumor was not determined. In 1890, Hochenegg [7] removed a portion of the under surface of the liver measuring 3.5 x 4.5 cm. in a 58 year old female. The diagnosis was metastatic carcinoma, and the primary lesion was believed to be in either the pylorus or colon. The involved portion of liver was incised by knife; he attempted to suture the liver, but his sutures tore through. The hepatic stump was fixed in the abdominal wound. W. W. Keen [8] in 1892 reported a partial hepatectomy for an adenoma of the bile ducts. His enucleation was accomplished with thermocautery, and the edges of the liver wound were united by five silk sutures. In a comprehensive report on tumors of the liver, Cullen [9] in 1905 reviewed the literature and reported a case of a large carcinomatous tumor of the liver, which was removed 17 months after nephrectomy for carcinoma of the left kidney. He reported a temporary recovery and stated that the patient was in good health eight months after surgery. Haim [10] in 1925 successfully resected a lobe of the liver infiltrated by a carcinoma of the gallbladder. He emphasized that metastases involving only one lobe of the liver do not contraindicate a radical operation for carcinoma of the gastro-intestinal tract. R. Nissen [11] (1930) performed an extensive partial hepatectomy and cholecystectomy for an adenocarcinoma of the gallbladder which had infiltrated the right lobe of the liver. In 1936, Möller [12] reported the case of a 29 year old female who, after repeated laparotomies for recurrent ovarian tumors with secondary malignant degeneration (granulosa cell carcinoma), had a liver metastasis the size of a fist removed by resection of the liver. Six years after partial hepatectomy no signs of recurrences or metastases were noted. Cattell [13] (1940) reported a case in which he removed a secondary growth from the liver during the first stage of a two-stage abdominoperineal resection. He stated that there was some involvement of the regional lymph nodes at the rectosigmoid, the site of the primary lesion, but no lymph node involvement could be found near the site of the hepatic metastasis. Microscopic study showed that the

blood vessels were invaded within the tumor, and this probably accounted for the means of spread through the superior hemorrhoidal veins. Coller and his associates [14] also noted evidence of direct local invasion of venous channels in 15 per cent of rectal specimens studied. This further emphasizes the fact that metastases can occur by means of vascular embolism of tumor cells. Wangensteen [3] in 1945 reported a group of three cases in which secondary excisions of hepatic metastases had been performed. Two of these secondary partial hepatectomies were done for rectal malignancies, and the third was performed on a patient who had a pelvic colon carcinoma. The latter had metastases excised from both lobes of the liver. Brunschwig [5] (1947) also reported the excision of hepatic metastases at the time the primary growth was resected in several patients.

That these metastatic nodes must be kept in mind and thoroughly sought for during the course of operation for a primary lesion elsewhere needs no further emphasis. To accomplish this, however, adequate exposure and thorough mobilization of the liver are absolute prerequisites. Enormous solitary hepatic nodes may be overlooked; this has been brought out in a discussion by Mallory [15] commenting on a case in which both a carcinoma of the stomach and a large secondary mass in the liver were overlooked.

CASE REPORT

History.—C. H., a 58 year old white male, entered the American Hospital on Mar. 2, 1947. He stated that 12 days prior to entrance he felt nauseated and 2 days later began to vomit. His bowels had not moved for 10 days. He claims that he noticed vague epigastric distress about five months ago. This was associated with a dull cramplike type of pain which was periumbilical, and at times radiated backward toward the spine. For the past five months he had been getting progressively more constipated, during which time he had also lost about 25 lb.

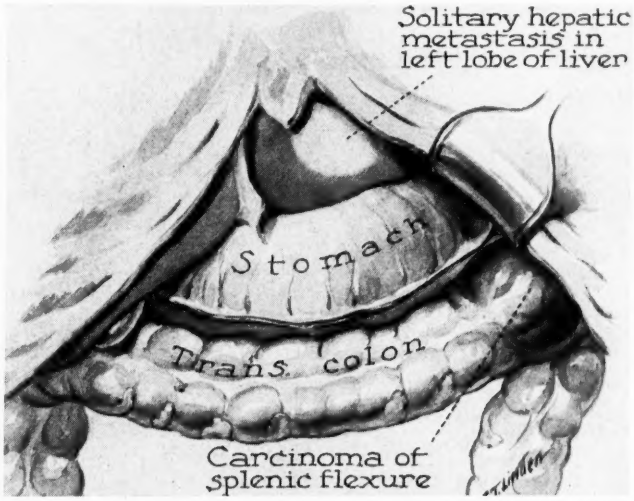

Fig. 1.—Primary carcinoma of splenic flexure and large solitary hepatic metastasis.

Physical Examination.—This revealed a rather poorly nourished male with a temperature of 99 F., pulse 80 and respirations 20. Blood pressure was 142/90. The umbilicus was slightly above the xiphopubic line, denoting some degree of distention. There was some tenderness around the umbilical region, and a right inguinal hernia easily reducible was noted. Abdominal auscultation revealed some hyperperistaltic rushes with an occasional obstructive borborygmus. The examination was otherwise essentially normal.

Laboratory Report.—The roentgenologist reported the following: "scout film examination of the abdomen reveals a considerable amount of fecal material in the descending colon and a large amount of gas in the ascending colon. Repeated examina-

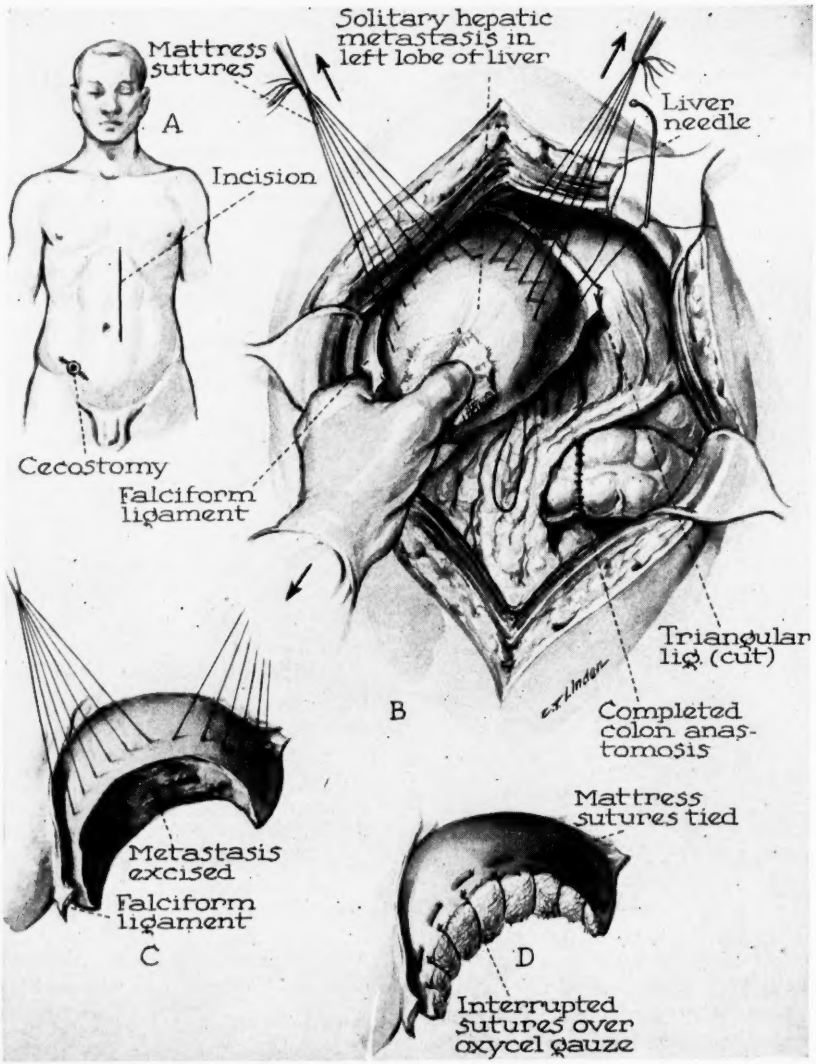

Fig. 2.—*A*. Long left rectus incison extending from xiphocostal angle to an inch or two below umbilicus permits adequate exposure, exploration and proper mobilization of organs to be resected. Previously performed cecostomy also seen. *B*. Hemostatic suture ring made by passing mattress sutures through entire thickness of left liver lobe; special liver needle used. Resection of tumor and end-to-end anastomosis performed. *C*. Metastatic node and contiguous liver tissue resected. Upward traction maintained on suture line for hemostasis. *D*. Mattress sutures tied and piece of oxygel gauze placed along cut liver surface. Latter is held in place by interrupted cotton sutures.

tions of the colon by barium enemas on two subsequent days revealed a complete obstruction at the splenic flexure. A malignant neoplasm is suspected." With the exception of a mild secondary anemia, routine laboratory studies were essentially negative.

Treatment.—Two days after entering the hospital the patient became more distended, and repeated enemas failed to relieve the large bowel obstruction. It was decided that a blind cecostomy should be done to relieve the obstruction. This was performed on Mar. 4, under local anesthesia, and was accomplished through an exaggerated McBurney incision which hugs the right anterior superior iliac spine. The distended cecum immediately bulged into the wound; this was exteriorized by a piece of iodoform gauze placed between it and parietal peritoneum. Two clamps steadied the exteriorized segment of bowel. Two days later the cecostomy was opened and functioned well. The patient was placed on a high calorie, high vitamin, nonresidue diet. Adequate sulfasuxidine was given until the stool became odorless and gelatinous. Eleven days after the cecostomy, Mar. 15, an exploration was done through a long left rectus incision; the anesthesia was continuous spinal (Fig. 2, *A*). A firm irregular mass about the size of a small orange was found at the splenic flexure. The regional mesenteric lymph nodes were enlarged, but the mass was freely movable. A large solitary lemon-sized node replaced most of the left lobe of the liver (Fig. 1). It was decided to do a partial colectomy and a partial left lobe hepatectomy. The splenic flexure was mobilized by cutting the left phrenicocolic ligament, the left parietal peritoneum and the left half of the gastrocolic ligament. The greater omentum was left attached to that part of colon which was to be removed. The involved colon and its mesocolon were removed about 6 in. distal and proximal to the splenic flexure. An aseptic end-to-end anastomosis over clamps was done with continuous 000 catgut. Since no other metastases were noted, the left lobe of the liver was then mobilized by cutting its triangular ligament. The large solitary metastatic node with surrounding liver tissue was removed in the following way: mattress sutures of no. 10 crochet cotton were passed through the entire thickness of the left liver lobe. A special blunt-pointed liver needle, a modification of the Kousnietzoff [16] needle, was used and the stitches placed so that they formed a hemostatic suture ring (Fig. 2, *B*). These were not tied but were held upwards, thus maintaining traction and compressing the liver parenchyma and vessels. The metastatic node and contiguous liver tissues were removed. (Fig. 2, *C*). The sutures were then tied. An additional layer of no. 24 interrupted cotton sutures was placed within the hemostatic suture ring and tied over oxycel gauze, which was placed against the cut surface of liver tissue; in this way hemostasis was adequately obtained (Fig. 2, *D*). The abdomen was closed in layers without drainage. During the operation 1,000 cc. of whole blood was used.

Pathologic Report.—The pathologist reported an adenocarcinoma of the large bowel with metastases to the regional lymph glands and a large solitary metastasis to the left lobe of the liver.

Postoperative Course.—The patient's first three postoperative days were somewhat stormy; however, following this he made an uneventful recovery. Adequate caloric, electrolyte and vitamin balance was maintained throughout his stay, and he was discharged on the twenty-fifth postoperative day. Seven weeks following the resection, he returned for closure of the cecostomy and was discharged one week later, having normal bowel movements and gaining weight. On Aug. 12, five months after surgery, during the course of a routine follow-up examination, some slight bilateral dependent edema of both lower extremities was noted. The right lobe of the liver was slightly palpable. He continues to feel well, however, and is gaining weight.

SUMMARY

1. An extensive search of the literature revealed a marked paucity of reports dealing with the removal of portions of the liver for metastatic lesions.

2. A case is presented, wherein a partial colectomy was performed for an adencarcinoma of the splenic flexure, and a partial left lobe hepatectomy was carried out for a solitary liver metastasis.

3. Operations performed for the removal of metastatic lesions are justifiable since there is some chance for success, and failure to remove the lesion results in death.

4. The palliative effects brought about by the removal of metastases are well worth while.

SOMMAIRE

1. Une recherche approfondie de la littérature révèle seulement un petit nombre de cas, où il fût fait une ablation de tissu hepatique pour lésion métastatique.

2. L'auteur présente un cas dans lequel il

enleva un portion du colon pour un adénocarcinome de la coudure splénique et un même temps, il fit un hépatectomie partielle du lobe gauche du foie pour une métastase solitaire du foie.

3. Ces opérations pour l'ablation de lésions métastatiques sont justifiables. Parfois les résultats sont bons. La non-ablation des métastases est toujours suivie de mort.

4. Les résultats palliatifs qui résultent de l'ablation des métastases sont très satisfaisants.

SUMARIO

1. El estudio de la literatura del cáncer revela raramente mención de la resección de segmentos del hígado en las lesiones metastaticas.

2. El autor presenta un caso de adenocarcinoma de la flexión esplénica del colon que fué operado con colectomia parcial y resección de una porción del lobo izquierdo del hígado que habia sido invadido por un nodulo solitario canceroso.

3. La resección de lesiones metastaticas es justificable por cuanto aumenta las posibilidades de la curación del paciente, en cambio lo contrario es de muerte segura.

4. Los resultados paliativos de la resección de lesiones metastaticas es de por si evidente.

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DECUBITAL ULCERS

(Continued from page 605)

cubitale e un adolorosa complicazione in casi dove usuale termina colla morte. Egli rapporta una originale tecnica applicabile alle ulceri con una base intatta dove l' osso di sotto non e presentevole infettato o necessaria la rimozione. Un importante punto nella tecnica e la necessita per esagerata dorsale soprosso della natica per prevenire la mancanza di rimarginazione di tirare della gravita nelle linea di saturazione dell anca paralizzata.

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Modern Anesthesia

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IN the last decade such vast progress has been made in surgery that we are rapidly accomplishing the surgeon's aim which Lord Moynihan [1] so ably stated when he said "Now that operations are made safe for the patient, let us strive to make the patients safe for the operation." The former has long been achieved by applying our knowledge of anatomy, pathology, antisepsis and asepsis; the latter is being rapidly achieved by the application of our increased knowledge of physiology in such fields as anesthesia, nutrition, pre- and postoperative care, wound healing and early ambulation. Added to these is a better understanding and treatment of such complications as shock, atelectasis, embolism and thrombosis, intestinal obstruction and sepsis. Attention to all of these must be given by the surgeon long before the operation is performed. This begins with the preoperative preparation of the patient and continues long after into the postoperative period of recovery. Thus, surgical morbidity and mortality have steadily decreased and the amount of improvement and number of cures steadily increased. In this report I should like to review only the subject of anesthesia and present the important contributions that have been made in the last few years.

The perfect anesthetic is the one that nullifies pain and secures complete relaxation and yet interferes to a minimum with body functions while the operation is being performed. The introduction of newer agents and technics of administration has led in recent years toward fulfillment of this ideal. The trend today is away from employing a single anesthetic agent, but rather to using two or more which act at different levels of the nervous system. This offers the advantage of less total anesthetic and better anesthesia or what is described as "balanced anesthesia."

THE VARIOUS TYPES OF ANESTHETICS MOST COMMONLY USED IN THE UNITED STATES AT THE PRESENT TIME AND THE ROUTES BY WHICH THEY ARE ADMINISTERED

		Administration
I. *General Anesthesia*		
Liquids:	Ether	Inhalation
	Chloroform	Inhalation
	Vinethene	Inhalation
	Ethyl Chloride	Inhalation
	Alcohol	Intravenous
Solids:	Procaine	Intravenous
	Barbiturates	Intravenous
	Avertin (Tribromethanol)	Rectal
Gases:	Nitrous Oxide	Inhalation (oral and intratracheal)
	Ethylene	Inhalation (oral and intratracheal)
	Cyclopropane	Inhalation (oral and intratracheal)
Anesthetic Adjunct:	Curare (muscle paralyzant)	Intramuscular or intravenous
II. *Regional Anesthesia*	Cocaine	Topical application
	Novocaine (Procaine)	Infiltration, diffuse, local
	Bromsalizol	Nerve or Plexus block
	Metycaine, Nupercaine	Spinal: Single dose and continuous
	Pontocaine, etc.	Saddle block
		Caudal (sacral)
		Paravertebral
	Ice	Nerve block by refrigeration of local part
	Refrigerated Air	

LIQUID INHALATION ANESTHETICS

Ether.—Diethyl oxide is still the anesthetic most employed. Its administration, either by the open drop or closed method using modern gas machines, offers the patient a wide range of safety and the surgeon satisfactory relaxation. It is easily given and is often used to overcome failure with other methods and agents. Lundy's [2] report for the year 1945 at the Mayo Clinic for a total of 29,516 operations showed that ether was used in 33 per cent of these. In less than 600 cases, the drop method was used. In spite of this, a special effort was made to train all of the anesthetists at the Clinic during 1944 in the use of ether by the open drop method, so that, if other agents failed or anesthetic machines broke down, the anesthetist could always achieve good relaxation and correct breathing and ventilation by this method. To attempt to abandon this method entirely is unwise, for is would remove the one opportunity left to the anesthetist when all other means fail. At the present time, when ether is given, it is best preceded by a 50 per cent N_2O and O_2 induction and/or intravenous sodium pentothal. It is, however, contraindicated in the aged, nephritic and arteriosclerotic patients as well as those with acute or chronic pulmonary disease.

Chloroform and Vinethene (Vinyl Ether).—These agents are little used in this country because of their toxicity and low margin of safety. Chloroform is excellent in obstetrics where quiet breathing and periodic relaxation are needed; it also minimizes respiratory and gastric disturbances. Its prolonged use, however, is toxic to the heart muscle, liver and kidneys; therefore it should not be used when disease of these organs is present. Its one advantage over the other agents is that it is not inflammable.

Vinyl ether or vinethene is liquid like ether and is administered by inhalation for rapid induction. It is likewise toxic to the heart, liver and kidneys. It must be given in low concentration and with a tracheal airway in place. It produces poor muscular relaxation and therefore can only be used when light anesthesia of short duration is required. Because other superior anesthetics are available, there really is no excuse for its use.

Ethyl Chloride.—Like chloroform, this is a very potent agent and must be used with great caution. It is excellent for rapid induction and is safe where anesthesia of short duration and little relaxation is needed. It also damages the heart, liver and kidneys and should not be used in the presence of affections of these organs. In removing foreign bodies superficially placed, and in lancing superficial abscesses, it is often employed as an analgesic by freezing the part involved.

INTRAVENOUS ANESTHESIA

Alcohol.—Alcohol as an intravenous anesthetic agent was first fully described in 1929 by Marin.[9] This agent never became popular because it was attended by such complications as hemolysis, shock, decreased urinary output, vascular sclerosis and occasional nerve injury from extravasation at the site of injection. Ten years later, Mueller [13] reviewed 2,000 cases in which 5–10 per cent alcohol solution was used as the anesthetic, and this created a renewed interest. Recently Moore and Carp[14] reported a series of 150 cases and discussed the physiologic effects previously studied by Jetter, Melanby and Miles.[14] Russian literature [15] also contains numerous articles on alcohol as an anesthetic agent.

When 1,000 to 3,000 cc. of 5–10 per cent alcohol in 5 per cent glucose is administered intravenously to the average adult over a period of 24 hours, the sensorium is dulled. Anxiety disappears and a feeling of well-being results. Pulse, temperature and blood pressure remain about the same, but respirations are increased. Skin appears somewhat flushed from vasodilatation. Headache, nausea and vomiting do not occur, as is the case when alcohol is given orally. There is usually an increase in urinary output, due rather to the fluid intake than to the action of the alcohol as a diuretic. Over 90 per cent of the alcohol is completely oxidized in the body, 2 per cent is eliminated through the kidneys, 0.5 per cent by the lungs. Normally, 10 cc. of 85 per cent alcohol is metabolized per hour and remains a constant regardless of the blood concentration. Levels above this produce intoxication; 200 cc. of 5 per cent alcohol solution will contain this amount, and quantities above this, infused per hour, will produce the clinical sedation needed. This varies according to the tolerance of the patient, and therefore the rate of infusion must be judged by the subjective symptoms.

In nutritional disturbance due to gastro-intestinal disease, alcohol is of value because it overcomes starvation. One liter of glucose, 5 per cent solution, provides 200 calories and the added 5 per cent alcohol (50 cc.) contributes another 400 calories—this has a marked conservation action on the protein reserves, for the solution is entirely utilized and not stored. Addition of vitamins to the solution does not render it inactive in any way.

In the cardiac patient, this agent is also of value because of its vasodilatating properties and because it offers a safeguard against pulmonary complications such as atelectasis. If there is any danger in giving large amounts of fluid to this type of patient, then a 10 per cent solution of alcohol in glucose can be used, thereby reducing the amount of fluid by half.

In debilitated and morbid patients, restlessness and pain are alleviated; in the cancer patient there is less need for opiates; in the alcoholic patient—who is known to be anesthetized with much difficulty using other agents (except pentothal sodium)—analgesia and sleep are quickly produced.

The postoperative recovery is smooth; the patient "sleeps off" the effect of the anesthetic; there is little need for opiates because sedation continues for a long time, and the return to consciousness is often unaccompanied by memory of the operation.

The Russian technic of administration is different [15]—amounts of 1.5–3 cc. per Kg. body weight are given to produce analgesia and sleep. Morphine is given half an hour previously, and then a solution containing 33 per cent alcohol and 3.5 per cent glucose is slowly infused for 15–20 minutes. After 40–60 cc. alcohol (120–180 cc. of solution) has been given, the patient goes into deep surgical anesthesia, having passed quickly through the excitement stage. The face, neck and conjunctivas become red, lips slightly cyanotic, pupils fixed and contracted, skin warm, respirations regular and pulse, blood pressure and temperature unaltered. When this deep anesthesia is induced, the vein is flushed with 40 cc. physiologic saline solution to prevent thrombophlebitis. The patient awakens after three to four hours and may be irrational, requiring special attendance and restraint.

Because this agent is inexpensive and safe, it has become quite popular in Russia and is preferred in bone work where extreme relaxation is not needed. It is little used in this country, but it might have a place as an adjunct to regional anesthesia (infiltration, block or spinal). So far no contraindications to its use have been discovered.

Procaine, Intravenous.—Although the widest application of procaine is by regional administration, some attempt has been made recently [16] to use this agent intravenously for producing analgesia in injured extremities. Based on the fact that increased permeability occurs in traumatized and inflamed tissues, solutions of procaine were administered intravenously, and it was noted that they permeated the injured sites, rendering them dulled or insensitive to pain. One gram is dissolved in 500 cc. isotonic sodium chloride solution and slowly administered intravenously. Pain in an extremity is promptly relieved and continues to be relieved for four to five hours afterward. Sensitivity to the drug must first be ruled out by a small intradermal injection. Any reaction that follows may be controlled by epinephrine or barbiturate, and further administration of the anesthetic must be discontinued.

In such conditions as crushing injuries, diabetic gangrene or other peripheral vascular conditions, procaine may offer some aid in management. Because of its toxicity and because other agents are more safely and quickly administered, it seems to us that there is no need to use this agent in setting fractures and dislocations.

Barbiturates.—Barbiturates have now been used for some 20 years in anesthesia and can be divided into two groups—those that have a prolonged action and those that are of short duration.

Those of the prolonged action group (like sodium amytal) were toxic to heart, liver and kidneys and were therefore not suitable. They are no longer used for narcosis and have been replaced by the short action group, of which pentothal sodium is the most generally used. Its popularity can be demonstrated by noting that in 1945, at the Mayo Clinic,[7] it was used in 25 per cent of all surgical procedures.

Pentothal Sodium.—Ten years ago Lundy [7] introduced pentothal sodium, and its popularity and method of intravenous administration have steadily increased. It is without question the outstanding advance in anesthesiology and is to be preferred to any other agent for use by the intravenous method. Lundy reports its use, alone or in combination with other agents, 7,000 times in 18,443

operations during 1943 and 25 per cent of the time during 1944 and 35–40 per cent of the time in 1945. Heard [8] and Adams [9] further attest the popularity of this agent and its method of administration, for it is both a complete anesthetic as well as an adjunct to inhalation or regional anesthesia and fits perfectly into the recently emphasized trend toward balanced anesthesia.

Pentothal sodium is safe when used correctly by those experienced in its properties and action, because it is controllable, rapidly detoxified and readily eliminated. It has been used successfully over a wide range of age groups. One group of statistics [10] showed a range of age of 10 months to 102 years. It offers comfortable induction, steady anesthesia and satisfactory postoperative recovery. No contraindication exists except when patients are allergic to barbiturates; when properly administered, it does not harm heart, liver or kidneys.

Holly [11] used pentothal sodium without ill effect in patients with decompensated heart conditions, in those recovering from coronary occlusion, in the tuberculous, asthmatic, hypo- and hypertensive patients and in cases of obesity. In patients with severe liver disease, this agent produced no complications. Postoperative study of urine in all cases failed to show the presence of the drug. Administration is started in the hospital room for nervous patients to avoid apprehension. By further injection, the patient is brought to and maintained at full surgical anesthesia level.

One of the great advantages of pentothal sodium is that it can be used in conjunction with any anesthetic, and in particular when spinal anesthesia is wearing off.

The technic of administration is as follows. Forty cc. distilled water is added to one ampule of pentothal sodium (which is prepared in 1 Gm. amounts) to make a 2.5 per cent solution. The solution must be freshly prepared and not allowed to stand for more than four hours. Solutions must be clear; those clouded or precipitated should be discarded.

The solution is put in a three-way valve syringe —one valve for the syringe, another for the attachment of rubber tubing with an intravenous needle and the third for administration of intravenous fluids such as saline, glucose, plasma, blood, etc. Injection is made very slowly, because smoothness of anesthesia and safety depend not only upon the strength of the agent but also upon the rate of injection. The initial respiratory depression, usually expected during the induction, is thereby also reduced. Surgical anesthesia is established when quiet, regular and somewhat depressed respiration occurs, when the lid reflexes are abolished and when the eyeballs become fixed centrally. The anesthetist must remember that this drug is cumulative in its action, and therefore only smaller doses are needed to keep the patient at the required level. At lighter levels, the eyeballs begin to oscillate, lid reflexes return, respirations become noisy and the extremities move. Overdosage, on the other hand, is easily recognized by shallow respiration and cyanosis, and if allowed to continue, will produce total cardiorespiratory paralysis. Treatment of this state must begin at once by stopping further administration and ventilating the lungs with 10 per cent CO_2 and oxygen. In anticipation of this possible occurrence, *an intratracheal airway should always be kept in place,* early in the induction period, as soon as the jaws relax. Coramine, metrazol and picrotoxin are further administered because of their stimulating effect on the respiratory center and cerebral cortex.

Total dosage of pentothal sodium is usually from 1 to 2 Gm. and depends upon the type of patient, body weight and length of operation. Larger doses of 3, 4 or 5 Gm. were observed by Lundy [2, 7] to produce a stormy postoperative recovery attended by restlessness, headache, nausea and vomiting—just like that with the now discarded long-acting barbiturates. By using the usual premedication with morphine and atropine and an inhalation mixture of 50 per cent N_2O and oxygen, the quantity of drug used can be markedly reduced and the tissues flooded with adequate oxygen. Besides N_2O and O_2, other forms which can be combined with pentothal sodium are local block, spinal and curare. This results in a balanced anesthesia by allowing the separate agents to act upon various parts of the nervous system, thus avoiding the need for large doses of pentothal sodium. Unlike inhalation anesthesia, it produces no period of excitement, there is no struggle and therefore no attendants are necessary to restrain the patient. The robust patient as well as the weak, the heavy drinker and smoker as well as the total abstainer—all are quickly anesthetized. Anesthesia occurs in 30–60 seconds when relaxation is complete, and the patient is then ready for operation. Pentothal sodium anesthesia more than any other resembles

normal deep sleep with its quiet, regular respirations and warm, dry, pink skin.

The postoperative recovery is smooth, there is usually no headache, nausea and vomiting and no restlessness; postoperative pain is less severe and there is less need for sedatives. The airway must be left in place until full consciousness returns. Ten per cent CO_2 and oxygen inhalation is given to ventilate the lungs at the completion of the operation to stimulate respiration and to avoid atelectasis. Patients who have had experience with other anesthetics feel that this is the ideal agent. In the hypertensive patient, the initial dose might have to be increased from the usual slow administration of 2–4 cc. to as much as 6–8 cc. of the 2.5 solution to achieve proper induction prior to the use of the inhalation anesthesia. Larger amounts of 10–20 cc. may produce too much respiratory depression, making the supplementary administration of inhalation anesthesia very difficult and dangerous. Pentothal sodium is excellent in cases of emergency surgery, when the patient is unprepared and has a full stomach. There is no vomiting and therefore little danger of aspiration exists.

The drug was extensively used by the armed forces in the tropics and elsewhere when inhalation anesthesia was obviously not practicable, and because it was sometimes necessary to get the patient ambulant and conscious on short notice for immediate evacuation. It was combined with regional anesthesia. Patients thus treated were kept at a drowsy or sleepy level. One of its therapeutic uses during ether anesthesia is for the control of ether convulsions. It is given intravenously, in 2.5 per cent solution, slowly, until the convulsions cease—usually 1–4 cc. of the solution is needed. However, if this should fail to control the convulsions curare can be used.

The complication from pentothal anesthesia are few and range from headache, vomiting and restlessness to laryngeal spasm and respiratory depression; the last can be avoided by introducing an intratracheal airway early and by administering the drug slowly and in small amount. The one complication that must be avoided is that of local tissue destruction at the site of injection because of faulty injection. To prevent sloughing from such accidental perivascular tissue infiltration, Harrison and Elder [12] have suggested the immediate infiltration of the area with 10 cc. of 1 per cent procaine HCl solution without epinephrine. No destruction will ensue if this is done promptly. Lundy has verified this observation.

Today, pentothal sodium used alone is the most popular anesthetic for the short operation where relaxation is not needed. Combined with other agents in the form of balanced anesthesia, it is gaining popularity for extensive procedures.

RECTAL ANESTHESIA

Avertin.—This white crystalline chemical is tribromethanol and is prepared in a solution of amylene hydrate containing 1 Gm. of the drug to 1 cc. of solution. It is mixed with a suitable amount of water and administered rectally. Usually, 70–100 mg. of avertin (.07 to .1 cc. of solution) per Kg. of body weight is given. Care must be taken to test the solution for deterioration to avoid toxic effect. The test is made for the presence of free bromide using Congo red and noting change in the color.

Avertin is regarded and used as a basal anesthetic agent, and complete unconsciousness is produced in one half to one hour. Total anesthesia is not obtained with the dose employed; therefore, gas, ether or local infiltration with novocaine is added, but in considerably reduced amounts.

The advantage of this agent is that it can be given in the patient's room. This avoids the apprehension of the operating room, which Crile so correctly pointed out and emphasized years ago in his "anosci association theory." Because it produces no significant change in pulse, respiration, blood pressure or psychic state, it is ideal for use in brain surgery where it finds its chief application. It is also used to some extent in pediatric surgery.

The one contraindication to the use of avertin is the presence of any rectal disease, for rectal necrosis and ulceration may result. As a disadvantage one might mention the prolonged depression that continues postoperatively, and which might lead to development of pulmonary complications. This factor necessitates close watching and encouragement of deep breathing.

GAS ANESTHESIA

The use of gas agents such as N_2O, ethylene and cyclopropane has varied some in the past years. The development, however, of more efficient gas machines has made administration of these gases easier and safer because of the smaller quantity of agents needed. Likewise, the introduction of calcium chloride by Waters [3] for the absorption of excess moisture and carbon dioxide has greatly enhanced their effective and safe use. Lahey [4] states that at his clinic 15 gallons of gas are needed for a goiter operation when the CO_2 extracting apparatus is used, as compared to 85 gallons needed before this was available. This is a saving of 70,000 gallons of ethylene per year plus a distinctly better anesthesia at his clinic.

Nitrous Oxide.—Anesthesia by this agent is rapid and pleasant due to rapid absorption by the tissues and the lack of obnoxious odor. Recovery from it is likewise rapid because of its quick elimination; nausea and vomiting are at a minimum. This prompt recovery almost obviates the need for postanesthetic attendance. There is no pulmonary edema or excessive bronchial secretion, and cardiac depression is minimal. This tremendously reduces the incidence of cardiorespiratory complications. It is ideal for such minor surgical procedures as manipulation of stiff joints and for changing painful dressings, and wherever light anesthesia is indicated. It is not inflammable and therefore can be used where cautery is employed.

The great disadvantage is that one cannot get good and complete relaxation with this agent alone in abdominal work. To accomplish this, it would have to be given in such high concentration (95 per cent), that the quantity of available oxygen in the tissues would be reduced to anoxic levels, and a fatality might result. Recently, the adjunct use of curare has widened the scope of application of nitrous oxide by overcoming this difficulty. Last year, at the Mayo Clinic,[2] over 50 per cent of the operations were done under nitrous oxide anesthesia combined with other agents. Its greatest value, by far, in major surgery today is for induction anesthesia only.

Ethylene.—This gaseous agent is more potent than nitrous oxide and gives better muscular relaxation and reduced asphyxia of tissues, because it can be given in such concentration as to allow administration of 20–30 per cent oxygen. For gynecologic surgery it is ideal, for there is not the need for such complete muscular relaxation as in upper abdominal surgery. The hazard of its inflammability prohibits its use where cautery or electric instruments are used. Lundy [2, 7] reports the use of ethylene as sole anesthetic in only 3 per cent of all operations during 1945 at Mayo Clinic.

Cyclopropane.—Of the three gaseous agents, this is the most potent. Because it is administered in small concentration (10 per cent), it can be used with a high concentration of oxygen (90 per cent). Like ethylene, it is highly inflammable and has a narrow margin of safety. It is especially ideal as an anesthetic in chest surgery. It is contraindicated in the presence of heart disease, for it causes increased irritability of the myocardium, which may lead to a fatal arrhythmia.[5] Should this occur, immediate intravenous injection of 3–5 cc. of a 1 per cent novocaine solution (30–50 mg.) may abolish the arrhythmia by reducing the irritability of the myocardium.[6] Its inflammability can be reduced by using a mixture of helium and yet allowing sufficient concentration of oxygen to avoid anoxia.

ENDOTRACHEAL (INTRATRACHEAL) ANESTHESIA

The endo- or intratracheal method [27] of administering inhalation anesthetic agents is becoming more and more popular as more anesthetists become trained in its application. It offers a safe and smooth anesthesia, because of the constant assurance that an open tracheobronchial airway exists. It is without question the most desirable method in operations on the chest, upper abdomen and for intrathoracic goiter. Collection of mucus in the air passages can easily be aspirated, mucus plugs that may give rise to postoperative atelectasis are easily removed and if the need arises, artificial respiration can be given. Postoperative ventilation of the lung following prolonged surgical procedures and reinflation of the collapsed lung attendant on intrathoracic operations are best carried out with this method. With this anesthesia the breathing is quiet, and there is no straining and

better relaxation. This is especially desirable in operation in the upper abdomen. Adequate doses of the anesthetic agent are quickly introduced with no waste and definite economy in cost to the hospital.

Several tubes have been devised and are of several lengths and diameters to accommodate various sizes of tracheas. The one most used is a soft, large-bored Magill tube, made of a woven silk or lastex rubber, with or without an inflatable cuff to establish a completely closed breathing system. A built-in catheter in the lumen of these tubes allows aspiration of accumulated secretion.

The tube is inserted after spraying the nose and throat with 5 per cent butyn solution, and a light general anesthetic using 2.5 per cent pentothal sodium intravenously or inhalation of nitrous oxide and oxygen is given. A soft mouth prop of sponge rubber is also placed between the teeth. With the patient supine, and the head well extended, the tube is either passed through the nose, blindly past the glottis into the larynx and trachea or orally by direct vision using the laryngoscope. Care must be taken to be gentle, for trauma to the airways is followed by edema and possible infection. Contraindications to this method are infections about the mouth and pharynx, larynx and pulmonary tree.

ANESTHETIC ADJUNCTS

Curare (Intocostrin).—The paralyzing properties and lethal effects of curare have been known for many centuries to the South American natives who painted their darts and arrow tips with it. Its therapeutic application has been worked out only since 1938, when Gill [17] brought a quantity of the drug from Peru for scientific investigation. It has long been known that curare acts at the myoneural junction, thus inhibiting the transmission of impulse from nerve to muscle, and also that this effect is lost when the drug is removed from the circulation. This dramatic muscular relaxation by temporary paralysis was used by Bennett,[18] a psychiatrist, to prevent fractures during convulsive therapy. This led to the thought that curare might also be of value in relaxing the musculature for surgical purposes. Griffith [19] of Montreal, an anesthetist, was the first to make such use of curare, in 1942.

Curare or intocostrin does not abolish pain and must therefore be used in conjunction with some anesthetic agent. To obtain both the effects of relaxation and anesthesia, with any one anesthetic agent, the dose, as was shown by Cole,[20] must be so great as to exact the penalty of creating respiratory and cardiac depression, liver damage and possible death. Curare remarkably reduces this excess in quantitative need of anesthetic agent. The drug, at the present time, is marketed in vials of 5 cc., representing 20 mg. of highly purified drug per cc., with the toxic substances, responsible for cardiac and respiratory depression, removed. Intocostrin made from crystals of d-tubocurarine HCl is now being used instead of the other preparations. It is the same in strength and action and it has the advantage of being more stable. The dose is figured at 1 mg. per Kg. of body weight.

At the Mayo Clinic,[21] curare is being used more and more in upper abdominal surgery for obtaining good muscle relaxation. For an average adult, light anesthesia of cyclopropane is first given with a preliminary injection of morphine and atropine. An airway is then placed in the trachea and 3 cc. (60 mg.) of intocostrin injected intravenously slowly, at the rate of 1 cc. per minute, just as the fascia is being opened. If satisfactory relaxation is not produced on entering the peritoneal cavity, after 3–5 minutes a further slow injection of 2 cc. is made (40 mg.). Special attention is paid to respiration and blood pressure—both are somewhat depressed. Too large a dose of the drug and too sudden injection lead to complete respiratory (intercostal) paralysis and apnea. If this results, artificial respiration must be instituted, or pressure made on the bag of the anesthesia machine and the lungs ventilated with a 50 per cent CO_2 and 95 per cent oxygen mixture. Lundy has found that such a mixture with the anesthetic agent is ideal for preventing respiratory depression when curare is used.

Keeping an intratracheal airway *always in place* keeps the glottis and cords open and the airway clear. If these measures should fail, then prostigmine, which is an antagonist to curare, is injected as an antidote. Keeping close watch on the respirations at all times and promptly discontinuing the drug at the first sign of depression will help to avoid such

alarming reactions. Some patients are hypersensitive to the drug and may show respiratory arrest; therefore, some artificial respiratory means must always be at hand to be given immediately.

In the patient who is a heavy smoker and drinker, laryngeal spasm with cyanosis may develop under any type of anesthetic agent and as a result, narcosis is difficult to obtain. Curare has been found to be ideal in such cases, because it relaxes the glottis and the cords; inhalation anesthesia can then proceed smoothly.

Curare is a safe drug in the hands of the experienced but must not be used by those not acquainted with its action. Since the vocal cords are in an adducted position under curare, an airway must always be in place before administering the drug. Normally the cords are abducted; this allows easy introduction of the tracheal tube and avoids trauma. Adequate means of artificial respiration must be at hand to assure prompt ventilation of the lungs, should this need arise.

When extensive abdominal surgery must be performed in the debilitated patient, and spinal anesthesia is contraindicated, a light general anesthesia will not produce the necessary abdominal relaxation. Curare, however, given in conjunction with a light anesthesia, such as ether, nitrous oxide or cyclopropane and oxygen, will produce this needed relaxation. Such management offers smooth postoperative recovery with little or no prostration. We have all worked with cases where the abdominal muscle relaxation was none too good throughout the operation, or the effect of the general anesthetic agent wore off, thus making closure of the abdomen difficult at the conclusion of surgery. This can easily be overcome by giving a small dose of curare together with an inhalation of 50–80 per cent N_2O and oxygen. It must be remembered that under anesthesia only a small dose of curare is necessary to produce relaxation. Cullen [22, 23] has found that most patients tolerate a dose of 60 mg. of curare. If this is not enough, half this amount, 30 mg. is given after five minutes; to this may be added further smaller doses to produce the necessary optimal relaxation and quiet breathing desired. This state is usually maintained until closure. In operative procedures lasting more than one hour, the effect of curare begins to wear off and another half of the initial dose, 30 mg., is needed to facilitate replacement of intestines, closure of the peritoneum and abdominal wall. This effect is produced in 1.5 minutes and lasts for 20 minutes. Hudson,[24] reporting two series of cases, one in which curare was not used and one in which curare was used, states that the operative results were better in the latter as regards relaxation, shock and smoothness of recovery.

Like pentothal sodium, curare is of short action in the body and disappears rapidly from the blood stream. The respiratory arrest, which has been mentioned may occur early following administration of the drug. This can easily be overcome by artificial ventilation with a 5 per cent CO_2, 95 per cent oxygen mixture, and if too great a depression should occur from the unwise administration of too large a dose of curare, prostigmine should be given at once along with the artificial respiration.

In the immediate postoperative period, it is important to maintain constant observance of the patient by good nursing, until the weakened intercostal muscles regain their vigorous power of contraction and the danger of atelectasis has passed. Such weakness usually lasts for several hours after operation, and the incidence of atelectasis has been noted to be higher than in a control series.

Griffith,[25] in a series of 10,000 cyclopropane anesthesias combined with curare to promote the necessary abdominal relaxation, reports not a single instance of death. At no time was the anesthetic agent "pushed up" to obtain relaxation, and thus the danger of cardiac arrhythmia and arrest was avoided. Intravenous curare immediately secured the necessary relaxation.

Knight [26] looks upon curare as a great boon to anesthesia because it removes one of the chief nuisances and dangers, namely laryngeal spasm, so often encountered in light anesthesia. Curare promptly relieves this spasm. Curare, administered by a competent anesthetist, can therefore be safely used when all the above mentioned conditions are intelligently observed.

Cocaine.—This agent is used entirely now for topical application in 2 to 10 per cent aqueous solution or very cautiously in crystalline form mixed with a few drops of adrenaline, 1:1,000 solution, for surface anesthesia of mucous membranes, the nasopharynx, urethra, bladder and conjunctiva. The one disadvantage to its use is its toxicity which can be best controlled by giving a dose of barbiturate the night and morning before its use. The other is that it is habit forming. It is never to be injected, as fatalities have resulted.

Novocaine (Procaine).—Forty years have passed since Einkorn introduced novocaine as a local anesthetic agent. Many other similar agents have been introduced since, but none have displaced novocaine from its prominent position as an injectable agent. With it, satisfactory and safe anesthesia can be quickly produced at any part of the body without the necessity of narcotizing the entire body. This infiltration form of anesthesia is especially to be preferred when shock, severe toxemia, marked debility and head injuries are present, or when minor surgery is to be done. Solutions of ½–2 per cent are used in amounts not exceeding a total of 2–4 Gm. of drug. Besides the diffuse infiltration, local nerve block, continuous spinal and continuous caudal anesthesia, paravertebral nerve and paravertebral sympathetic block are also used. Diffuse and nerve block infiltration methods need no discussion except to say that when local infection exists or is feared, penicillin[28] can be admixed to the solution. Neither one nor the other nullifies each other's effect; there is no detraction from the anesthetic effectiveness or from the bacteriostatic effect of penicillin. When it is thus used, 250 Oxford units of penicillin are admixed with each cc. of 0.5–1 per cent solution of novocaine or metycaine. Similar studies are being made with streptomycin to determine if we can have anesthetic solutions bacteriostatic for both the gram-negative and -positive organisms. Occasionally with such solutions containing penicillin, an allergic reaction is seen at the site of injection, but nothing more. As regards the addition of sulfonamides, these can only be mixed with metycaine, because procaine (novocaine) nullifies the bacteriostatic effect of the sulfa drugs.

Bromsalizol.—This new drug was recently introduced as lengthening the effect of regional nerve block.[29] It is especially useful in sympathetic nerve block and paravertebral nerve block as in sciatica, producing prolonged anesthesia of several days' or weeks' duration. It is prepared in 10 cc. amounts of 0.4 per cent solution in peanut oil. When placed correctly in the tissues about the nerve, no nerve or tissue necrosis results.

Continuous Caudal Anesthesia.—For work about the perineum or vaginal repair and rectal surgery, sacrocaudal and continuous caudal anesthesia is satisfactory. The technic for the latter procedure has been recently worked out by Hingston [30] and applied in obstetrics. This has effected painless childbirth in thousands of cases and a demand for it by the expectant mother.

The single injection caudal anesthesia is made by introducing the ordinary spinal puncture type needle into the caudal canal. For continuous anesthesia requiring hours of anesthesia, the fear of breakage of such needles led to the development of a malleable needle by Lemmon,[32] and more recently this has been replaced by a no. 5 ureteral catheter.

After preparation of the lumbosacral area, a 15 gage spinal puncture needle is passed through the sacrococcygeal ligament into the hiatus sacralis. When the needle comes in contact with the bone on the anterior border of the canal, it is rotated 90 degrees caudad to bring it in line with the long axis of the canal. It is then advanced 1 in. (2.5 cm.). For this, the patient is placed on the abdomen with the sacrum elevated. Aspiration is made for the presence of spinal fluid. If fluid is present, the subarachnoid space has been entered due to a low lying dural sac. The needle must be withdrawn until no fluid appears, indicating that the proper space is entered; the injection can then be safely begun. Aspiration of blood must also be avoided for numerous extradural veins might be punctured. First, 2 cc. of 1.5 per cent novocaine or procaine solution is given slowly and, if taken well, 20–30 cc. of solution is injected slowly. The syringe is now detached from the needle and a no. 5 French nylon ureteral catheter, previously sterilized by autoclaving, is passed through the needle and advanced until its tip is about 1.5 in. or 4 cm. above the hiatus sacralis. The needle is then removed, while the catheter is carefully supported in place. The catheter is then taped to

the skin with adhesive and dressings placed about it to prevent soiling from the perineum. The patient is turned on the back and made comfortable. Additional injections through the catheter are made using 25 cc. amounts of solution, administered slowly whenever the patient complains of discomfort. At times there may be some evidence of vascular collapse with fall in blood pressure. This may be prevented by adding 2 minims of adrenalin 1:1,000 solution to the initial quantity of solution administered.

Siever and Mousel,[31] who have been particularly enthusiastic about the use of this method, have used it successfully in over 300 unselected obstetrical cases, and obtained lowered fetal mortality as compared with one of the other methods.

Complications that may arise are sudden collapse from introduction of the fluid into the subarachnoid space, as stated. Accidental administration of the anesthetic fluid into one of the extradural veins will also lead to vascular collapse and convulsions—as little as 5 cc. will cause convulsions. If this should occur, immediate administration of 2–5 cc. of a 2.5 per cent pentothal sodium solution intravenously will control the novocaine convulsions. Infection is another danger to be avoided, and this method of anesthesia must not be used when infection or inflammation exists about the lumbosacral region.

Because it is necessary to keep the needle or catheter in place for several hours during this method of anesthesia, and because of the proximity of the rectum, it is possible that infection can occur through contamination. To avoid this, some workers use penicillin admixture with the anesthetic agent; 250 Oxford units per cc. is the amount used. This is bacteriostatic and does not reduce the effectiveness of the anesthetic agent.

The contraindications to this method are gross abnormalities of the sacral region; infection of the skin over the lumbosacrococcygeal region; allergy and sensitivity to the local anesthetic agents and diseases of the spine and central nervous system. Patients who are apprehensive or neurotic or excessively obese are also not good subjects.

If the above conditions for application of this method can be satisfied and no contraindications exist, and a well trained anesthetist acquainted with its use is available, this method offers a most excellent anesthesia. It is inexpensive and requires no complicated apparatus.

Continuous Spinal Anesthesia.—Like caudal anesthesia, spinal anesthesia, because of the danger of sudden vasomotor collapse and inadequate duration for the long operation, has been improved upon by a continuous method of administration. The equipment needed is the same as that used in continuous caudal anesthesia: a spinal puncture needle of no. 15 gage, a ureteral catheter no. 5 and 10 per cent procaine solution.

Earlier, when malleable needles were employed, the patient lay on a specially cut-out mattress with the removable segment lying beneath the lumbar spine; this prevented displacement or kinking of the needle. With the catheter method this is no longer necessary.

The technic is as follows. The skin at the desired interspace, usually between the third and fourth lumbar vertebrae, is cleaned and spinal puncture is made. Spinal fluid is aspirated to see that the subarachnoid space has been entered and that no vein has been punctured. Sufficient fluid is aspirated to make the necessary dilution of the anesthetic agent. A short-acting agent like procaine in 10 per cent strength is used, and this is diluted to make a 3 per cent solution (3 cc. of 10 per cent solution diluted with 7 cc. of spinal fluid will make 10 cc. of 3 per cent solution). The ureteral catheter is passed through the spinal needle into the subarachnoid space for 6–7 cm. beyond the point of the needle, which is then removed and the catheter taped to the skin and dressings applied to prevent contamination. With the patient supine, the catheter is fixed to the side of the body, and attached to a two-way 10 cc. Luer syringe, containing the 10 cc. of the diluted 3 per cent anesthetic solution; this represents 300 mg. of drug. About one third of this (or 2.5–4 cc.) or 90–120 mg., are given initially. By tilting the patient to a varying degree, head down, the anesthetic reaches the desired level. Usually this effect is attained in a few minutes and will last for 45–50 minutes. Further administration of 1 to 2 cc. of the 3 per cent solution (30–60 mg.) may be required if sensibility and muscle movement with loss of relaxation return. With pontocaine a much smaller dose is used because it is eight to ten times more potent than novocaine.

In cases where an overdose of the agent has been given, Lemmon[32] has found that de-anesthetization can be accomplished by diluting the agent by irrigation of the subarachnoid space with saline solution. At the close of the operation, the catheter is removed and a dry sterile dressing is applied.

Preliminary injection of pressor drugs such as ephedrine, neosynephrine or methedrine help to stabilize the blood pressure which otherwise might become alarmingly low. These pressor substances

are given subcutaneously or intramuscularly just prior to giving the spinal agent; 25 mg. of ephedrine or 2 mg. of neosynephrine HCl are sufficient.

In a series of 2,500 spinal anesthetics, Dripps and Deming [33] studied the effect on the blood pressure. Five hundred cases which received no preliminary pressor drugs showed an average fall of 36 per cent in the preoperative blood pressure; 500 cases which were given paradrene showed a fall of 18.6 per cent in blood pressure; 500 which were given ephedrine had a fall of 14.5 per cent in blood pressure, and the last 500 which were given methedrine showed a fall of only 3 per cent in blood pressure. It made no appreciable difference whether procaine or pontocaine was used.

Usually the immediate postanesthetic effects from this method are vomiting, nausea or retching. Headache occurs in about 5 per cent of cases, but is not severe and clears up in a few hours or a few days. Inhalation with 5 per cent CO_2 with oxygen may relieve these unpleasant reactions. Urinary retention occurs in about 5 per cent of cases.

The more serious complications are infection of the subarachnoid space by contamination or injury to the cord with resulting paralysis or persistent paresthesia. Breakage of the catheter has also been reported; a catheter should not be used more than 10 times.

Spinal anesthesia should not be given to the irritable patient. In presence of infection or abnormalities of the lumbosacral region, cord diseases and injury, or when a herniated intervertebal disk is suspected, this method must definitely not be used. Its chief advantages are that no expensive equipment is needed for its administration, and it is suited for long operations. It must be given, however, only by those familiar with its use.

Saddle Block.—This is a form of low spinal anesthesia for sacral nerve block using a small quantity of concentrated agent in heavy solution (hyperbaric). This method is particularly adapted to urologic, rectal, gynecologic (perineal), obstetric and orthopedic operations.

The technic as devised by Adriani and Roman-Vega [34] is as follows. Usual preparation of the lumbosacral area is carried out and a preliminary injection of morphine, gr. 1/6–1/4, scopolamine, gr. 1/100–1/150, is given one hour before the spinal injection. The patient is seated, and spinal puncture is made at the fourth or third lumbar interspace; the freshly prepared solution of the spinal agent in 10 per cent glucose is injected. If procaine or metycaine is used, 75 mg. is dissolved in 1 cc. of the glucose solution and this amount is given; if pontocaine is used, 5 mg. of drug is used, and with nupercaine only 2.5 mg. is used. Twice the amount of solution (2 cc.) is given for anesthesia beyond the saddle area, extending into the extremities and up to the first lumbar level. Anesthesia will last 1–1½ hours with procaine or novocaine, 2–2½ hours with pontocaine and 3–3½ hours with metycaine. The patient is allowed to remain seated for 40 seconds after injection with the 1 cc. dose; with the 2 cc. dose the patient must lie down. This allows the agent to act upward on the lumbar root.

The injection is made rapidly with gentle pressure, taking care that the needle is in the subarachnoid space. No unusual complications follow, and there is no marked drop in blood pressure, provided that ephedrine or neosynephrine have been given just as is done in the usual technic of spinal anesthesia.

Plexus Nerve Block.[35]—Temporary interruption of either the sympathetic or peripheral sensory nerves can be used to advantage in both upper and lower extremities. The technic is not difficult and with a little care is absolutely safe.

In the upper extremity, brachial plexus nerve block is used for scalenus syndrome, causalgia, bursitis, osteoporosis, thrombophlebitis and Raynaud's disease. The injection is made just medial to the mid point at the clavicle and one finger's breadth above it. A 3 in., no. 22 gage needle is introduced at this point, at right angles to the long axis of the body and then swung 45 degrees from the horizontal, the patient lying flat, toward the mid line. The bone encountered is the transverse process of the seventh cervical vertebra; the injection is made after aspiration is done to ascertain that the needle is not in a vessel. This reaches the stellate ganglion as it lies in relation to the seventh cervical process; 2–4 cc. of 0.5–1 per cent solution of novocaine is used.

Lumbar Sympathetic Block.[35, 36]—This method was first introduced by Leriche in 1934 for diagnosing and treating vasospastic

early thrombophlebitis and sympathetic nerve disturbances of the lower extremities. In this country it was popularized by Ochsner and De Bakey. Lumbar plexus temporarily interrupts the nerve impulse outflow from the lumbar sympathetic ganglia and trunk and thereby abates the noxious stimuli in certain vasospastic and inflammatory conditions such as acute phlebitis, thrombophlebitis, lymphedema, arteriolar disease, early Buerger's disease, frost bite, certain osseous and joint diseases and nervous disturbances like causalgia. The pain in these conditions is often completely relieved, the blood supply improved and the lymph drainage increased. One of the chief uses of this method is as a diagnostic aid for prognosing the degree of spasm or organic occlusion in the vessels of the lower extremity.

The technic of lumbar plexus block is as follows. The patient is placed in a prone position and a small pillow or pad is placed beneath the pubis. Four skin wheals are raised bilaterally, 4 cm. lateral to the first, second, third and fourth lumbar interspinous ligaments, using 0.5 per cent novocaine solution. Through these wheals, 4 in., no. 22 gage needles are introduced vertically until bone is struck—the transverse lumbar vertebral processes. Then the needles are further introduced at an angle upward and medially for another 5 cm. This change in angle allows the needles to slide from the process and come to lie at the anterolateral aspect of the vertebral body, near the position of the lumbar sympathetic chain. After taking care to aspirate for the possible presence of blood, 5–10 cc. of 1 per cent metycaine solution with ephedrine in distilled water is injected at each point. Metycaine is used because it produces a prolonged anesthesia as compared to procaine, two to three times longer.

Injections may be repeated the next day or two or three times per week. If the response is good and a permanent effect is required, lumbar sympathectomy is indicated. Alcohol block is not advisable, because some of the cases so treated develop a very disturbing neuritis.

Sympathetic nerve block today constitutes the chief method of treatment for allaying pain and correcting the edema in many of the peripheral vascular conditions caused by trauma and vascular disease, and for such postoperative complications as early thrombophlebitis. In the latter it may be curative by abolishing the accompanying vascular spasm.

REFRIGERATION ANESTHESIA

Ice and Refrigerated Air.—The effect of cold on tissue as an analgesic and anesthetic has been known for a long time, but only in the last decade has this become a method of regional anesthesia. The local physiologic effects of cold are sedation, diminished circulation, decreased metabolism, reduced absorption and inhibited bacterial activity. Pain and spasm are abolished because the painful afferent impulses from the injured part are blocked, and primary neurogenic "pain shock" is not seen. Clinicians have long observed the lowered incidence of shock with injuries during the cold seasons. The decreased circulation and metabolism reduce the oxygen requirement to a level in keeping with that which is available as a result of the injury, thereby retarding tissue destruction. Inhibition of bacterial activity, lack of absorption of noxious material from wound site and prevention of local blood and fluid loss avoid the development of toxemia sepsis and secondary shock. Veal has further emphasized the absence of post-traumatic venous thrombosis and of pulmonary embolism.

Allen [37] was the first to make successful clinical use of these facts and employed ice for anesthesia in leg amputations in patients who were elderly, poor risks and very ill with sepsis and toxemia. To produce complete anesthesia of tissue, a temperature of 5 C. or 40 F. is necessary, and yet contrary to many beliefs and fears, does not damage or interfere with healing afterward. Lobache [39] showed this in animal experimentations. Proper slow thawing or defreezing by gradual reduction of cold over a period of two or three days, however, is most important in the immediate postoperative period. Tissue destruction would result from quick thawing.

If higher temperatures than 5 C. are used, incomplete or no anesthesia results, and if lower temperatures (below 0 C.) are used, histologic tissue destruction and irreversible protoplasmic cellular changes occur.

For simple incision and drainage of an abscess beneath the skin or for skin grafting, adequate anesthesia can be obtained in about half an hour by simply placing ice or ice bags in contact with the skin of the affected part.

For deep anesthesia, through-and-through, as in

leg amputation at the mid-thigh level, the extremity is packed in ice to 2–3 in. above the amputation level. After several minutes of this, a tourniquet can then be placed about the leg at the amputation level without causing pain and yet tight enough to cut off the blood supply to the distal part. Some 60 lb. of ice applied for three hours are required to produce total anesthesia at the mid-thigh level. In amputation through the calf of the leg or the foot, less time, about 1½ hours, would be sufficient. In toxic cases the tourniquet can be left on for days and weeks and refrigeration continued simultaneously. Amputation is deferred until toxemia clears up, infection abates and the general condition is improved. MacElveney [40] and Mock and Mock [41] have reported cases so treated. In this way a physiologic amputation is made first by using constriction and cold, and later this is followed by anatomic amputation at a higher level.

Further advantages of this method are that the needed surgery can be done painlessly, in full consciousness without suppression of the higher centers or vital functions of the heart, lung, kidney and liver. Most of these patients are in the older group and show some disturbances of these organs. Postoperatively there is no nausea, vomiting, depressed respiration and bowel function or asthenia. Most of the patients can be made ambulatory at once. There is no interruption in their feeding. Intubation, catheterization, sedation and cardiorespiratory stimulation are rarely required. Some recent work has shown that healing may be somewhat delayed, and the amount of wound secretion be increased because of failure of agglutination of the extravasated serum. Allen and Crossman [38] in extensive studies on refrigerated tissue have observed this.

As stated, it is most important to thaw out the part slowly. This is begun immediately in the postoperative period for the next two or three days. It is done by gradually reducing the number of ice bags or quantity of ice placed about the stump, so that by the third day all refrigeration is withdrawn. In this way "frost bite," necrosis, slough and edema with blistering can be avoided, and good healing assured.

Refrigeration today can be done with especially designed water- or air-cooled apparatus operated by gas or electricity. This avoids the inconvenience (and "mess") incidental with the melting ice, when the latter is used.

Refrigeration is offered as the anesthetic and treatment of choice in the badly traumatized extremity, grossly contaminated and in the presence of severe shock. Obviously, definitive treatment must be deferred, and immediate debridement under shock is also unwise. A wait of two days to two weeks in such cases before extensive debridement with excision, suture or amputation is done, allows the patient to overcome his shock and build up a good reserve and resistance, yet without danger of infection or sepsis from the gross contamination, provided proper refrigeration of the part is kept up. No change in the original appearance of the wound occurs; it remains fresh, is free of pain and without signs of infection. The Mocks [41] cite an interesting case of pelvic trauma with injury to the iliac and femoral vessels, torn urethra, head and chest injuries and gangrene of the lower leg treated by refrigeration alone for two and one half weeks. Amputation was deferred because of fear of fatality. At the end of this time, collateral circulation established itself, and successful amputation was done at a much lower level than would previously have been possible. In the late war, the Army and Navy had extensive experience with large tears and fractures of extremities treated by primary refrigeration for several weeks so as to allay pain promptly, control sepsis, inhibit infection and correct physical and nutritional deficiencies.

If amputation is not to be done, then the tourniquet is not used. In many patients the characteristic foul smelling, chocolate colored pus is changed in a few days to a colorless, odorless watery secretion. Swelling and inflammation are diminished, and the general toxic appearance due to sepsis disappears. Should clean ice not be available, in an emergency ordinary ice can be used, because it is not the gross contamination that is important, but the benefit that will follow from control of the infection.

Cases of infected gangrenous legs so treated show prompt reduction in fever, prostration and delirium, usually in 24–48 hours. Glycosuria and acidosis, requiring tremendous doses of insulin because of the infection, clear up now under smaller doses in the diabetic.

The markedly diminished blood flow in these extremities is best met by refrigeration because of the diminished absorption, reduced metabolism and tissue destruction and inhibited bacterial activity. It is by far the best plan of management at the present time.

GENERAL DISCUSSION

Today, with our broad knowledge of these various anesthetic agents and technics, it is seen that there is no one agent applicable to all patients. Every physician, be he surgeon, internist, specialist or general practitioner, should try to select the best of these for the individual case. This is best done in joint consultation with the anesthetist. The choice will depend on the physical and mental condition of the patient, on the type of operation to be performed and, most important, on the ability of the anesthetist and his knowledge of and experience with any particular agent or method. These newer agents and methods of administration call for carefully trained nurses and doctors to join the newly founded specialty of anesthesiology.

Sanders [42] reveals the true interdependence of surgeon and anesthetist, and states that we as surgeons acknowledge with full gratitude those scientists who at last have brought anesthesia to a scientific level, not only by the introduction of new agents but by the newer methods of their application. This scientific era now allows us a choice of inhalation, intravenous, intratracheal, regional block and spinal methods with effectiveness and safety. These advances have given the anesthetist a new role and a new stature. He has become the surgeons' most important advisor, for it is up to both to assure the patient a safe conduct through the operation and through the postoperative convalescent period.

SUMMARY

The rapid advances made in anesthesia have paralleled those made in surgery. Numerous new agents and technics have been introduced, so that a re-evaluation of the older agents and technics is constantly necessary. Single agents are no longer used, but rather combinations of two or more agents that act upon different levels of the sensorium, producing safer, better and quicker anesthesia, with a saving in total amount of agents required. By this is meant "balanced anesthesia."

For inhalation anesthesia, ether is still the anesthetic of choice and is preceded most often by nitrous oxide and oxygen induction. The introduction of the calcium chloride shell for the absorption of excess carbon dioxide and moisture makes inhalation anesthesia safer, more efficient and economical. Ethylene still enjoys its greatest use in gynecologic surgery, where complete relaxation is not needed. Cyclopropane is becoming more popular and is especially indicated in thoracic surgery, where a high oxygen concentration is desired. It must not be used in presence of cardiac arrhythmias, as fatalities have occurred.

Of the intravenous agents, the most commonly used is pentothal sodium. An intratracheal airway should always be present so that prompt and effective artificial respiration can be given, should respiratory collapse occur. Alcohol is little used in this country. Intravenous procaine anesthesia for crushing injuries of the extremities is discussed.

Intratracheal anesthesia is preferred for the difficult, long, upper abdominal surgical procedures, for intrathoracic operations and for involved neck operations, such as large and substernal goiters. This offers a smooth and safe anesthesia, for the airways can be kept open by frequent aspiration of mucus, and the lungs may be kept inflated and effectively aerated.

Curare is an important adjunct to anesthesia to secure muscular relaxation. It is a muscle paralyzant and must be used with caution, for cardiorespiratory failure may occur. Intratracheal intubation therefore should always be used with it.

Regional anesthesia most often employs novocaine (procaine), metycaine and pontocaine. Dosage and length of action vary with these. A popular method of administration for abdominal procedures is continuous spinal anesthesia. The continuous caudal method is used chiefly in obstetrics. Saddle block anesthesia and paravertebral sympathetic block for anesthesia, analgesia and for relieving

vascular spasm of the upper and lower extremities are presented.

Refrigeration anesthesia finds a definite application in surgical management of some of the diseases and traumatic conditions of the extremities. It is sedative, bacteriostatic and prevents absorption of septic and toxic substances from the local site. When amputation is required, this method offers the lowest mortality.

Modern anesthesia demands specially trained personnel. It has come of age as a new specialty—anesthesiology, and it permits the performance of many new and difficult procedures heretofore impossible because of high mortality.

SOMMAIRE

Les progrès de l'anesthésie parallènt ceux de la chirurgie. De nombreux noveaux agents et de nouvelles techniques ont été introduits, et il est constamment nécessaire de revaluer les anciens agents et les anciennes techniques. On emploie de nos jours souvent deux ou plusieurs agents réunis qui agissent sur différents niveaux du sensorium, et ainsi produisent une anesthésie offrant plus de sécurité et obtenant l'anesthésie plus rapidement.

Pour l'anesthésie par inhalation l'éther est l'anesthesique de choix. Souvent on préeède son emploi par l'oxide nitreux et l'oxygène. L'introdution de la coquille de chlorure de calcium pour l'absorption de l'excès du dioxide de carbone et de l'humidité, nous permet d'obtenir une anesthésie plus sure, plus complete et plus économe. L'ethylène trouve son emploi en gynécologie dans les cas où un relâchement complet n'est pas nést pas nécessaire. Le cyclopropane devient plus populaire et est surtout indiqué dans la chirurgie thoracique, où une haute concentration d'oxygène est à désirer. Il est contre-indiqué dans les arythmies cardiaques. Il y a en des fatalités. Des agents intra-veineux le pentothal sodium est le plus fréquemment employé. Une voie intratrachéale doit être à la portée afin qu'on puisse pratiquer la respiration artificielle en cas de collapse respiratoire. L'alcool est peu employé aux Etats-Unis. L'auteur discute l'emploi intraveineux de la procaïne comme anesthésique dans les traumatismes des extrémités.

L'anesthésie intra-trachéale est preférée pour les interventions prolongées, sur la partie supérieure de l'abdomen, pour les opérations compliquees sur le cou, pour les opérations intra-thoraciques et pour les goîtres sous-sternaux. Cette méthode nous offre une anesthésie souple et sûre car les voies respiratoires sont maintenues ouvertes par la fréquente aspiration du mucus et les poumons peuvent être maintenus dilatés et aérés suffisamment.

Le curare est un adjuvant utile à l'anesthésie pour obtenir le relâchement musculaire. Il paralyse les muscles et doit être employé avec caution, car il peut entraîner la faillite cardio-respiratoire. L'intubation intratrachéale doit toujours accompagner son emploi.

L'anesthésie régionale fait un emploi le plus souvent de novocaïne (de procaïne), de metycaïne et de pontocaïne. Les doses et la durée d'anesthésie varient avec ces differents agents. Une méthode populaire pour la chirurgie abdominale est l'anesthesie rachidienne continue. La méthode continue caudal est surtout d'un usage fréquent en obstétrique. L'anesthésie en "bloc" et l'anesthésie paravertebrale parasympathique sont employées comme analgésique, anesthétique et pour soulager les spasmes vasculaires des extremités supérieures et inférieures.

L'anesthésie réfrigérante trouve son application surtout dans le traitement des maladies et des traumatismes des extrémités. Elle est sédative, bacteriostatique et empêche l'absorption de substances septiques et toxiques du foyer local. Quand une amputation est indiquée, cette méthode diminue la mortalité qui accompagne ordinairement ces interventions. Anesthésie demande un personnel instruit expert. C'est une specialité nouvellé, qui permet des opérations qu'on n'aurait pas osé entreprendre avant les ameliorations modernes apportées dans le choix des agents anesthésiques et les perfectionnements modernes et recents de leur emploie.

SUMARIO

El progreso de la anestesia paralela el de la cirugia. Numerosos agentes y tecnicas nuevas se estan constantemente introduciendo hacen

necesario la revaluación periodica de los agentes y tecnicas mas antiguas. Hoy en dia se usan las combinaciones de dos o mas anesteticos para así afectar diferentes niveles del sensorio y producir una anestesia que es mas rapida y mas eficiente—"anestesia balanceada."

En la anestesia por inhalación el eter es aun el mejor agente y muy frecuentemente es precidido por la inducción de una mezela de oxigeno y oxido de nitrogeno. El uso del cloruro de calcio que absorbe el acido carbonico y el vapor de agua lo hace mas eficaz y mas economico.

El etileno en mas popular en la cirugía ginecología por cuanto en esta no es de importancia la relaxación muscular. El ciclopropano se esta popularisando especialmente en la cirugía del torax, pero su uso es contraindicado en presencia de la arritmía cardiaca, porque en estos casos ha producido fatalidades.

El pentotal sodio es el mas popular de los agentes intravenoso, pero su uso debe de ser siempre acompanado por la intubación traqueal para así combatir pronta y energeticamente el colapso respiratorio en caso de que este ocurra.

La anestesia intra-traqueal es preferible en las operaciones de larga duración.

Las inyecciones de curare son de valor para producir la relaxación muscular, pero se debe de suar con precaución por cuanto este agente puede producir la paralisis cardio-respiratoria. El uso del curare demanda la intubación intratraqueal.

La anestesia regional emplea la novocaina, pontocaina y meticaina. La anestesia espinal continua es muy popular en las operaciones abdominales de larga duración.

La anestesia caudal continua se usa principalmente en la obstetricia. La anestesia por refrigeración es de valor en las lesiones traumaticas de las extremidades y muy en especial en las amputaciones por cuanto su uso presenta menos complicaciones y lleva poca mortalidad.

La "anestesiología moderna" es una especialidad que requiere un personal competente y bien preparado en los diferentes procedimientos de la anestesia y en el uso de los numerosos anesteticos.

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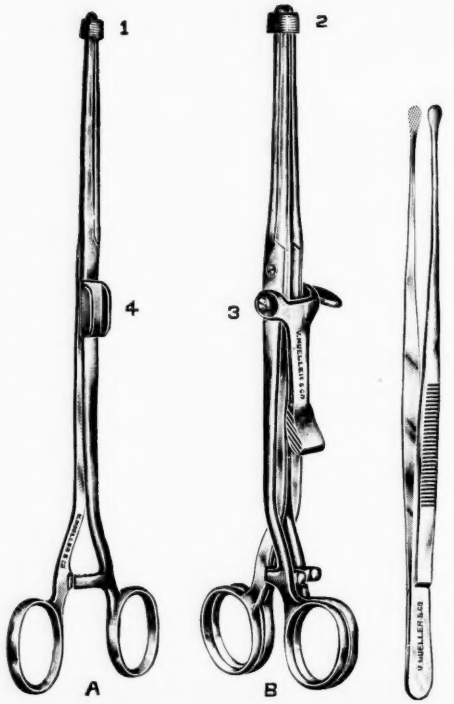

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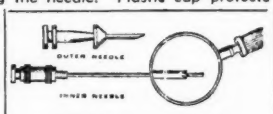

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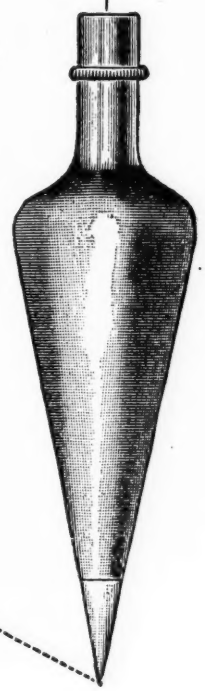

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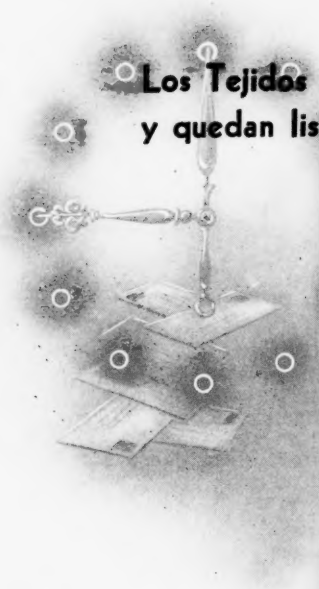
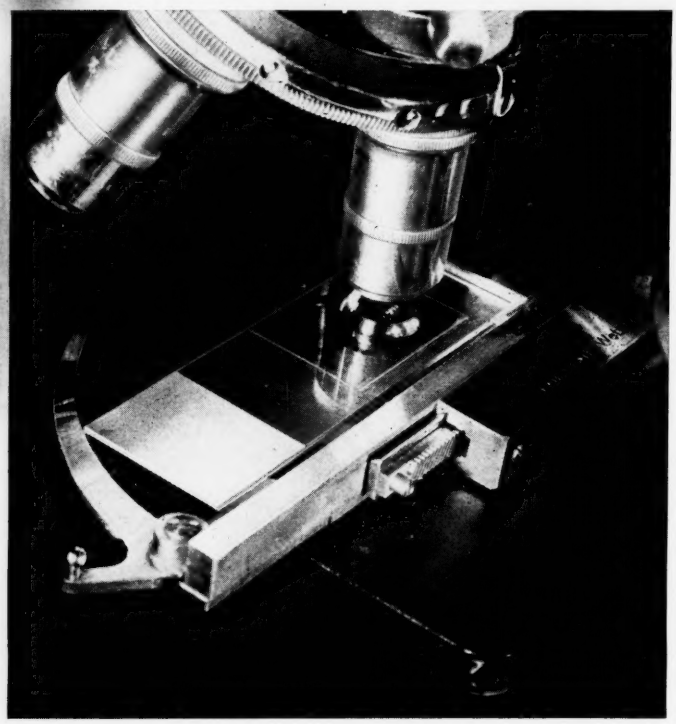
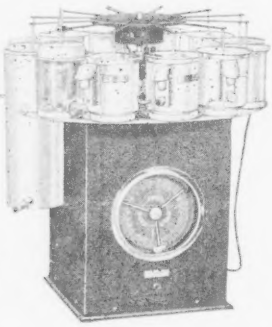




El **Autotechnicon** es un aparato que durante la noche realiza automáticamente la preparación histológica de los tejidos. Completa por si solo todas las fases necesarias para el examen de una preparación histológica, tales como fijación, deshidratación, infiltración, decalcificación y tinción, ajustándose perfectamente a cualquiera técnica. La aficacia del **Autotechnicon** ha sido bien comprobada incluso en las condiciones más adversas del trabajo de laboratorio, y en la actualidad se halla funcionando con extraordinario éxito en los hospitales más importantes del mundo. Las ventajas de este aparato son de incomparable valor, haciendo posible, mediante la preparación automática de los tejidos, que éstos puedan ser analizados por el anatomopatólogo sin pérdida de tiempo después de haber sido extirpados por el cirujano. Tanto el cirujano como el histólogo hallarán de sumo interés el folleto descriptivo del **Autotechnicon**, folleto que con agrado enviaremos a los profesionales que lo soliciten.

Autotechnicon

Prepara automáticamente los tejidos con cualquiera técnica histológica.



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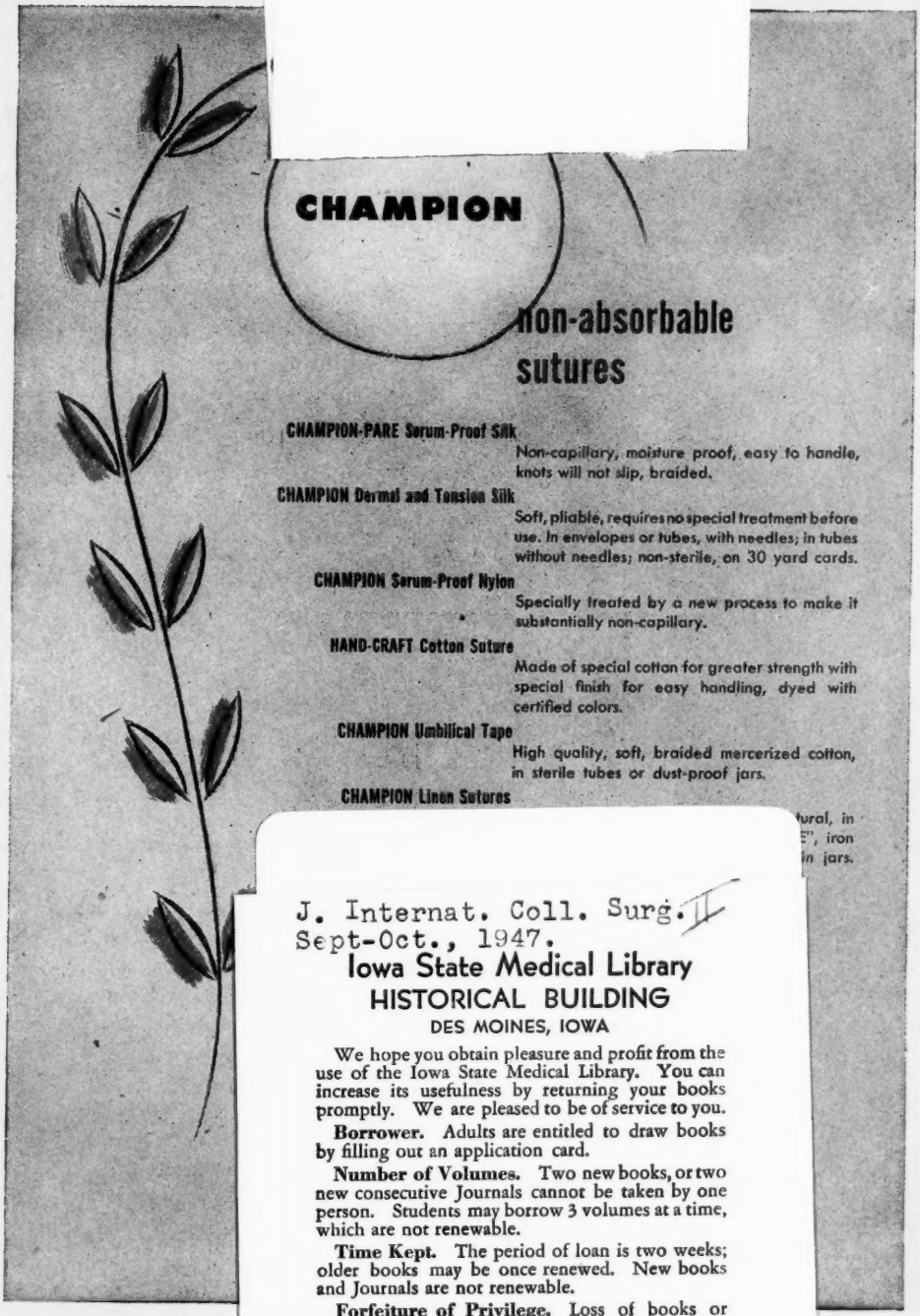
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